TECHNICAL MANUAL

RADIOSONDE SURFACE OBSERVING INSTRUMENTATION SYSTEM (RSOIS)

Organization Level Maintenance Manual

U, S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
MAINTENANCE, LOGISTICS & ACQUISITION, W/OPS1
1325 EAST-WEST HIGHWAY
SILVER SPRING, MD 20910

SAFETY SUMMARY

GENERAL SAFETY INSTRUCTIONS AND PRECAUTIONS

Comprehensive personnel, equipment, and safety instructions are contained in *National Weather Service (NWS) Engineering Handbook (EHB) No. 15, Occupational Safety & Health*.

WARNINGS, CAUTIONS AND NOTES

WARNINGs and CAUTIONs highlight installation or maintenance procedures, practices, conditions or statements essential to protection of personnel (WARNING) or equipment (CAUTION). WARNINGs and CAUTIONs immediately precede the step or procedure and consist of four parts: heading (WARNING or CAUTION), a statement of the hazard, minimum precautions, and possible result if disregarded. NOTEs highlight installation or maintenance procedures, practices, conditions or statements not essential to protection of personnel or equipment. NOTEs may precede or follow the step or procedure, depending upon the information to be highlighted. Headings used and their definitions are as follows:

*****WARNING*****

Highlights an essential installation or maintenance procedure, practice, condition, statement, etc., if not strictly observed, could result in injury to, or death of, personnel or long term health hazards.

CAUTION

Highlights an essential installation or maintenance procedure, practice, condition, statement, etc., if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

NOTE: Highlights an essential installation or maintenance procedure, condition or statement.

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1. INTRODUCTION

1.1 System Overview

The Radiosonde Surface Observing Instrumentation System (RSOIS) is an automated surface observing system used by the National Weather Service (NWS) to report data on surface parameters required by the World Meteorological Organization (WMO) Treaty for radiosonde (rawinsonde) deployment and radiosonde observation. The system has six major components: remote processing unit (RPU), temperature/humidity unit, wind sensor, base station, lightning/ground system, and directional antenna.

The RPU is housed in a stainless steel National Electrical Manufacturing Association (NEMA)-4 enclosure and consists of a system data logger (SDL), power supply, 12 volt battery, communications equipment (spread spectrum radio and fiber optic driver) and sensor ports.

The temperature/humidity unit consists of a combined air temperature (AT) and relative humidity (RH) sensor housed in an R.M. Young 43408F-12 Motor Aspirated Shield Assembly. The AT sensor is a YSI 44034 thermistor bead; the RH Sensor is a high capacity thin film polymer type HMP45D. Temperature output resistance and RH output voltage are sampled once per second.

Wind speed and direction are sampled by a Vaisala/Handar 425AHW Ultrasonic Wind Sensor which has thermostatically controlled heaters in the transducer heads to prevent freezing rain or snow buildup. The sensor is polled every five seconds and returns a five second vector average wind speed, vector average wind direction, heater circuit quality and other data.

The RSOIS Base Station (BS) is a battery-backed, commercial AC powered receiver and transmitter with a liquid crystal display (LCD). The BS communicates with the RPU via the spread spectrum radio. It is delivered complete with an antenna (left hand threads), power cable and RS-232 cable.

Additional descriptive detail is contained in Appendix A, *RSOIS DESCRIPTION*.

1.2 System Performance Characteristics

Table 1: System Performance Characteristics

Characteristic	Air Temperature	Relative Humidity	Wind Speed
Measurement range	-40°C - +60°C	0.8 - 100% RH	0 - 125 knots/hr
Accuracy	± 2° at 20°C	at 20°C factory references ± 1% RH field calibration ± 2% RH (0 - 90% RH) ± 3% RH (90 - 100% RH)	± 3% of reading (to 95.52 knots) ± 5% of reading (>95.52 knots) Wind direction: ± 2°
Response time		90% at 20° C 15 s w/ membrane filter	 0.35 s
Resolution			Speed: 0.1 knots/hr Direction: 1°

1.3 Environmental Operating Capabilities

The RSOIS is designed to operate under severe environmental conditions of high temperature and humidity and lightning as well as the wide range of biological effects of fungus, insects, and rodents. Environmental operating capabilities are listed below.

CONDITION	CAPABILITY
Temperature	Operates between - 40°C and + 60°C
Humidity	Operates during diurnal cycling with relative humidity up to 100%, condensing
Wind	Operates in steady state winds up to 120 MPH, with gusts up to tower limits
Rain	Operates during and after exposure to 20 in of rainfall per hour
Salt-sea atmosphere	Operates without degradation while subjected to salt fallout of 33.6 g/m^2/year
Fungus	Can operate during and after exposure to the fungi encountered in the rain forest
Solar radiation	Operable during and after exposure to 1080 W/m^2 solar radiation
Lightning	Protected through external and internal grounding, and circuit board level capacitors and diodes

1.4 Items Furnished

Each RSOIS system is delivered with the components shown.

Hardware Components

Remote Processing Unit (assembled in enclosure)	NEMA-4 stainless steel enclosure housing the 38 amp hour Battery, Fiber Optic Driver, Power Supply, Zeus Spread Spectrum Radio with antenna cable and heater, and Zeno®-3200 Data Logger (SDL) with terminal cable. The Technician's Cable is separate from the enclosure.
Temperature/ Humidity Unit	R.M. Young 43408F-12 Motor Aspirated Shield Assembly containing: YSI 44034 thermistor, Vaisala HMP45D Relative Humidity Sensor, and brushless motor blower fan with fan-fail detect
Wind Sensor	Vaisala/Handar 425AHW Ultrasonic Wind Sensor with cable and mounting arm
Base Station (optional)	Modified Zeno®-3200 data logger with: Zeus Spread Spectrum Radio, display, battery, antenna (left hand threads), and power supply
Lightning/Ground System	Lightning and grounding rods with associated mounting and connective hardware
Directional Antenna	2.4 GHz ISM MYP Yagi Antenna

Manuals

1. Organizational Level Maintenance Manual, NWS EHB 9-201
2. RSOIS Operation Manual (Coastal Environmental Systems S-200-Zeno®)
3. Zeno®-3200 User Manual (part of RSOIS Operation Manual)
4. User's Guide, Model 425 Series of Ultrasonic Wind Sensors, Handar (part of RSOIS Operation Manual)
5. Operating Manual, HMP45A & HMP45D Humidity and Temperature Probes, Vaisala (part of RSOIS Operation Manual)
6. Manual, Model43408F Gill Aspirated Radiation Shield, R M Young Co. (part of RSOIS Operation Manual)

Installation instructions

1. Organizational Level Maintenance Manual, NWS EHB 9-201
2. NWS Modification Note 2, EHB-9, Volume 2, Section 3.2
3. RSOIS Operation Manual

1.5 RSOIS Test Equipment

Table 2: RSOIS Test Equipment

Equipment	Requirement/Use	Source
AEMC Model 3630 Ground Resistance Test Kit	Pre-installation measurement site ground resistance (if required)	RSOIS installation site
Handar 425-7010 Margin Verifier	To detect slow deterioration of the wind sensor before it significantly affects accuracy	NLSC stocked item (not provided with system) ASN: S200-1A3AT1
Vaisala HMI41 Indicator	Air temperature probe calibration - performed biennially at the designated depot	Designated depot
Vaisala HMK13B or HMK15 Calibrator	Humidity probe calibration - performed biennially at the designated depot	Designated depot
Digital multi meter	Measure 425AHW shunt resistor resistance value	RSOIS installation site
Procomm V 4.7 *(or any terminal type software, e.g., hyperterminal)*	Direct system interface	NLSC (Project: ASOS) ASN: S100-TE318-2 NSN: NWS9-83-420-001

2. SYSTEM DESCRIPTION

2.1 Radiosonde Surface Observing Instrumentation System

The RSOIS is an automated surface observing system used by the NWS to report sensor data as required by WMO treaty for radiosonde (rawinsonde) deployment and radiosonde observation. The system's functional and physical components are detailed in Appendix A, *SYSTEM DESCRIPTION*, and summarized in this section.

2.2 Remote Processing Unit

The RPU is enclosed in a stainless steel NEMA-4 enclosure containing the SDL, power supply, 12-volt battery, communications equipment (radio and fiber optic driver) and sensor ports. Surface parameters are sampled and data is received, compiled and stored from different sensors. Radio linkage is via the frequency-hopping Zeus Spread Spectrum radio transmitter with Coastal Environmental's standard 1,200 baud FSK on-board modem and a Yagi antenna at the RPU end. This antenna has a 60° horizontal beam width and can be aligned visually. The radio and antenna system provides up to three miles line of sight communications. The Zeno®-3200 SDL controls the sensors, logs data, and controls communications. It is based on the Motorola 68332 32-bit micro-controller, with 512 Kbytes of flash program memory plus 1MB SRAM.

2.3 Temperature/Humidity Unit

The combined AT and RH sensors are housed within a Model 43408F-12 Gill Aspirated Radiation Shield which reduces radiation errors to less than 0.1°C. A glass encapsulated magnetic reed switch activated by an air flow detector is located at the intake providing fan fail protection. The unit is comprised of the YSI 44034 thermistor for ambient air temperature and the Vaisala HMP45D RH sensor.

2.4 Wind Sensor

Wind speed and direction are sampled by a Vaisala/Handar 425AHW Ultrasonic Wind Sensor with thermostatically controlled heaters in the transducer heads to prevent freezing rain or snow buildup. The sensor is set up in SDI-12 sub mode B.

2.5 Base Station

The BS is a battery backed, AC powered receiver and transmitter; that communicates with the RPU via the included spread spectrum radio. The BS receives radio messages, displays received data on its LCD, and passes the data to a personal/laptop computer. It can be mounted either independently or in a standard 19-inch rack mount configuration.

2.6 Lightning/ground System

The system employs four levels of lightning protection and diversion. The first level is the tower connected as directly as possible to an earth grounding system. The second level diverts the induced currents via the metallic electronics enclosure to earth ground. The third level uses a resistor-capacitor decoupling network, acting in concert with the fourth level which is a resistor-diode network. These networks are built into each line entering a sensitive

semi-conductor device and reduce any residual energies below the micro joule thresholds required to avoid component degradation or failure. The tower-mounted RPU and sensors are grounded with lightning rods meeting NEC requirements.

2.7 Directional Antenna

The directional antenna is a mast-mounted, vertically polarized MAXRAD MYP-24008 enclosed Yagi antenna for the 2400 - 2483.5 MHz frequency band.

2.8 System Interfaces

The RSOIS is configured to interface with, be controlled by, and display data on the NWS Radiosonde Replacement System Computer Workstation. An RS-232 maintenance interface on the SDL connects to the maintenance technician's laptop computer. Standard communication interface software is used to communicate with the system and to receive broadcasted data. The communication interface software can be any software independent of the operating system, and capable of receiving ASCII. Packages compatible with a DOS or Windows environment include: Procomm, Hyperterminal (included with Windows), and Reflections. Apple and UNIX-based systems can also receive ASCII text.

3. INSTALLATION AND SETUP

3.1 Required Parts

3.1.1 System Installation Kit

RSOIS installation kits contain:

K1 5 ft Lightning rod, 5 ft L-shaped cross arm, three - 8 ft copper clad grounding rods, 12 in copper grounding strap with attached aluminum bracket, three aluminum brackets, three copper brackets, two U-bolt assemblies complete with hardware (washer, lockwasher and 7/16 in nuts), and approximately 20 in twisted copper wire
K2 425AHW Wind Sensor, connecting cable, mounting cup w/hose clamp, and a bag of bird spikes (5).
K3 6 ft Wind Sensor arm with mounting hardware [6 U-bolts with washers (2), lockwashers (2), 7/16 in nuts (2) and square retaining bracket.]
K4 RPU Enclosure w/mounting plates, U-bolt assemblies, 5/16 in bolts, and desiccant
K5 Directional Antenna w/mounting U-bolts and antenna cable
K6 Temperature/Relative Humidity Unit w/ aspirated shield, pre-installed mounting bracket, U-bolt, and hose clamp
K7 RPU Battery

For those sites planning on using a radio link to receive data from the RPU:
K8 Base Station, power cable, antenna cable, RS232 terminal cable (not included with system for only fiber optic installation)

Figure 1: Packaged RSOIS

Figure 2: Packaged RSOIS Close-up

The system is normally delivered on a pallet plus two additional and separate longer boxes.

3.1.2 Site Furnished Material

Installing sites are responsible for providing the materials or parts listed below.

- Grounded disconnect box (to local code)

- Rigid right angle deep single gang covered outlet box with three 1 in threaded holes and GFI receptacle
- Green shrink wrap (¼ in)
- Electrician's putty (commercial grade)
- AC Power outlet
- Self-vulcanizing (Scotch -70 type) tape
- Assorted UV-resistant tie-wraps
- Di-electric compound (Dow Corning DC4 or equivalent)
- 1 in Liquitite non-metallic conduit (length is site-specific)
- General purpose lubricants and cleaning solvents (rated to -40° C)
- 14 ga, 2 wire solid copper wire
- Brushes and rags

3.1.3 Tools

Installation requires the following tools.

Ground resistance test kit, AEMC Model 3630 (*as required*)
1/8 in flat-blade screwdriver
Variable speed drill
Small side diagonal cutters
5/16 in drill bit
3/16 in Allen wrench
Socket wrench
Field compass
1 in open end socket
7/16 in open end wrench
Adjustable wrench
9/16 in deep socket
Climbing harness
Heat gun
7/16 in deep socket
Pliers
5/16 in nut driver
425AHW Solar Noon Alignment Tool, NWS S200-TE-316 (*ordered separately*)
Torque wrench

3.2 Installation Checklist

Complete the checklist in Appendix B as each step in the installation and system initialization process is completed.

3.3 Hardware Installation

3.3.1 Pre-installation Requirements

Tools and materials: Grounded disconnect box, covered outdoor outlet box, power outlet

Follow the procedures below prior to initial RSOIS installation.

1. Obtain approval of the responsible MIC/OIC/Observer before starting installation.

2. With the MIC/OIC/Observer, determine the prevailing wind direction at the site, and the best direction and location for mounting the wind and temperature/humidity sensors.

3. Siting Criteria for the Radiosonde Surface Observing Instrumentation System (RSOIS) tower and sensors shall meet the following requirements:

   a. Located within 200 m (656 ft) of the balloon launch area. The surface must be in its natural state and grass kept to a height of no more than 20 cm (7.87 in). The area should not be walked on except along paths. Paths should not be of asphalt or concrete.

   b. The RSOIS tower shall not constitute a hazard to the radiosonde release. The location should be off to the side of the launch area and not in line launches in prevailing winds.

   c. Wind sensors must be mounted on a tower between 6.00 and 10.00 m (19.7 ft and 32.8 ft) above the ground. The downwind distance between the wind sensor and any obstruction must be at least 6 times the height of the obstruction. The siting of the wind sensor upwind of an obstruction can be twice the height of the structure. Wind equipment should be located outside this zone of influence.

   d. The temperature/RH sensors must be securely mounted on the tower between 1.25 and 2.00 m (4.10 ft and 6.56 ft) above the grass covered ground. Stations with significant snow depth accumulations shall mount the temperature and RH sensor 1.25 to 2.00 m (4.10 ft and 6.56 ft) above the worst month average snow depth. An acceptable site shall be over level ground, freely exposed to sunshine and wind, and not shielded by or close to obstructions such as trees and buildings.

   e. It is preferred for the wind sensor, temperature sensor, and RH sensor to be mounted on the same tower. However, if wind sensor siting is difficult, separation from the temperature and RH sensors can be accommodated. The wind sensor can be placed within 60 cable meters of the tower mounted data electronics enclosure

   f. The Precision Digital Barometer in the office must be located within 15 m (49.2 ft) cable length of the upper-air computer workstation to allow for direct data ingestion by the computer.

   g. If the radiosonde is launched from the roof of a building and ground-based siting of RSOIS is not feasible the surface sensors may be installed on the roof provided special arrangements are made to minimize roof top heating effects.

NOTE: All the above siting criteria must be met unless a waiver for a specific criteria has been granted by the Office of Climate, Weather, & Water Services.

4. Examine the tower for lightning protection. If the tower is not currently lightning protected, plan to install provided lightning rod at the top of the tower following steps in section 3.3.3.1.

5. Identify the availability and source of commercial 120 VAC 60 Hz power at the tower base. Power may be in an existing cabinet or in a ground-located outlet or disconnect box. If power is not available, it is necessary to install a grounded disconnect box with 115 V single phase 15 A service. Consult with the site's facilities representative to have this power installed. Run power service according to local code to a weatherproof outlet box and power outlet.

6. After determining the availability and source of power, find the circuit breaker for the outlet box/power at the tower base.

CAUTION

ALWAYS turn off AC power and "lock-out" the breaker prior to wiring RSOIS components.

*****WARNING*****

If tower does not appear to be properly grounded, consult with the facilities representative to have the tower ground inspected, and a ground installed.

7. Examine the tower for an effective ground which should be to local code or 25 ohms or less. The procedure for verifying site ground resistance is in section 3.3.2.

8. Identify the latitude of the installation site to the nearest second and note the Julian date.

9. Obtain the time of the solar noon at the installation latitude following the instructions in Appendix C, *OBTAIN SOLAR NOON*.

CAUTION

DO NOT place the lead-acid battery on bare concrete. This could cause the battery to prematurely self-discharge due to temperature stratification of the cell.

CAUTION

NEVER turn the Base Station ON without the unit antenna (left hand threads) connected. Serious damage to the radio may occur.

10. Identify the Base Station, see figure 3, (optional container K8) and the mounting hardware packaged in a plastic bag (not included with system for only fiber optic installation).

Figure 3: Opened Base Station with Power and Terminal Cables

11. Connect the antenna (left hand threads), power cable, and terminal cable. Plug the Base Station into a standard GFI protected 115 VAC grounded outlet to maintain a maximum charge on the battery.

3.3.2 Verifying Site Ground Resistance

Resistance to ground (earth) can be measured using the AEMC Model 3630 Ground Resistance Test Kit. This kit is completely self contained and provides meter, connection cables and grounding electrodes necessary to perform a "fall of potential" ground resistance measurement.

The ground cables connect to ¾ in diameter copper clad grounding rods. The number of ground rods is determined during site installation using a "fall of potential" resistance measurement technique. A sufficient number of rods should be installed to give a resistance to ground of less than or equal to 10 ohms.

After RSOIS installation, measure the resistance to ground at each ground cable using the AEMC Model 3630 Ground Resistance Test Kit (without disconnect of the ground cable from the RSOIS equipment). Verify the resistance at each ground is within the acceptance criterion pertinent to the site (typically 10.0 -25.0 ohms).

Tools and material required: Ground resistance test kit, dielectric compound

1. Locate the four ground cables which are connected to the site grounding grid. Using sandpaper, clean a 2.54 cm (1 in) strip on each of the ground cables for connection of the measurement cables.
2. Position the ground resistance tester on a reasonably level surface within 2.44 m (8 ft) of one ground cable.
3. Verify that the needle on the meter is zeroed. The needle can be adjusted by opening the front cover of the meter and turning the mechanical zero-adjust screw.
4. Ensure that no selection buttons on the left side of the meter are depressed. Perform a check of the battery capacity by momentarily depressing the OFF/BATT. CHECK switch and observing that the green O.K. indicator at the top left side of the meter face flashes, and the needle is positioned on the right side of the Battery Good (BATT. GOOD) scale.
5. Remove one of the T-shaped ground electrodes from the kit and drive the rod into the ground 16.8 m (55 ft) from the system ground cable. This ground electrode is the "Y" probe. Drive this ground electrode completely into the ground.
6. Remove the other T-shaped ground electrode from the kit and drive the rod into the ground 26.8 m (88 ft) from the system ground cable in line with both the "Y" rod and the system ground cable. This ground electrode is the "Z" probe. Drive this ground electrode completely into the ground.
7. Remove the 101 wire from the kit and connect the alligator clamp to the area of the system ground cable cleaned in step one above. Connect the spade lug end of the wire to the GREEN binding post on the meter, identified as "X."
8. Remove one of the 1501 reels of wire from the kit. Remove one reel handle from the kit and insert into the center of the reel on the side opposite the reel rewind knob. Connect the alligator clip on this reel to the "Y" probe installed in step five above. Connect the spade lug end of the reel to the YELLOW binding post (identified as "Y") on the meter.

9. Remove the other 1501 reel of wire from the kit. Remove the other reel handle from the kit and insert into the center of the reel. Connect the alligator clip on this reel to the "Z" probe installed in step six above. Connect the spade lug end of the reel to the RED binding post (identified as "Z") on the meter.

CAUTION

Maintain all ground connections while the meter is taking the measurement. Removal of ground wires while the meter is active may damage the meter.

10. Depress the voltage measurement button (AC V) and verify that the stray earth voltage is less than 10 volts. (Stray earth voltage may adversely affect the ground measurement.) If greater than 10 volts of stray earth voltage is measured, removing of AC power from the site may be required.
11. Depress the 100 ohm button. Depress the measure button (MEAS) and verify that the green OK indicator on the top left of the meter face is illuminated. (This indicator verifies that all connections are established.) Select the lowest usable scale by depressing the X10 ohm button and/or the X1 ohm button. The site grounding resistance is read from the ohms scale of the meter, with the value being multiplied by the scale selector.
12. After making the measurement, depress the OFF/BATT. Check switch on the meter.
13. Verify that the resistance to ground is within the tolerance specified for the RSOIS site. If the resistance is not within specification, repeat the test with the "Y" probe positioned at a distance of 18.3 m (60 ft) and the "Z" probe at a distance of 29.3 m (96 ft).
14. Select a second system ground cables and repeat the test, beginning at Step 2.
15. Repeat the measurement at each of the remaining system ground cables until all four cables have been tested.
16. Verify that at least two of the four ground measurements are within the tolerance specified for the site.
17. Wind the wire back onto the reels, remove the reel handle from the reels by depressing the retaining latch at the center of the reel and return reels and handles to the kit. Remove the two T-shaped ground rods and return them to the kit. Remove the 101 wire from the site grounding rod and return it to the kit.

NOTE: All ground wires should be as short as possible.

NOTE: Apply liberal amounts of dielectric compound to each connection, joining copper wire and non-copper clamp.

3.3.3 System Installation

3.3.3.1 Lightning Rod Installation

Tools and materials: Variable-speed drill, 5/16 in drill bit, socket wrench w/ 1 in open socket or adjustable wrench, climbing harness, UV-resistant tie-wraps, 7/16 in deep socket

1. From container K1 (8 ft 2 in x 5 in x 5 in), identify the 5 ft anodized aluminum lightning rod, 5 ft anodized aluminum L-shaped cross arm, three 8 ft copper clad grounding rods, 12 in copper grounding strap with attached aluminum bracket, three aluminum brackets, three copper brackets, two U-bolt assemblies complete with hardware (washer, lock washer and 7/16 in nuts), and approximately 20 in of twisted copper wire.

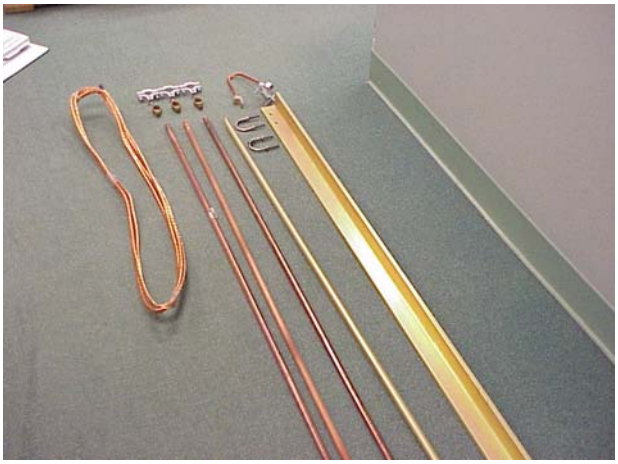

Figure 4: Lightning Rod & Mounting Hardware

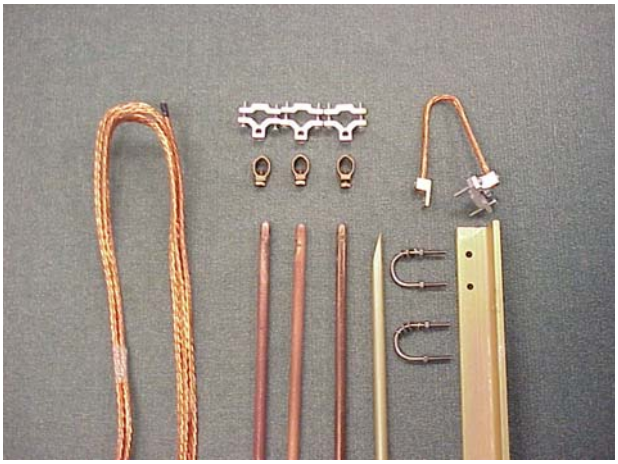

Figure 5: Lightning Rod and Mounting Hardware

2. Identify the correct location of the U-bolts on the L-shaped cross arm to fit the site's tower. Drill holes using a variable speed drill and 5/16 in drill bit.
3. Install the lightning rod on one end of the cross arm using a socket wrench with a 1 in open-end socket, or adjustable wrench. It may be necessary to drill the cross arm at the mounting point while it is on the tower.

CAUTION

Do not climb the tower without a climbing harness or use a bucket truck without proper training.

4. Using a climbing harness, climb the tower, or use a bucket truck, to access the installation point on the tower.

5. Place the cross arm in the desired location and hold in place using heavy tie-wraps.

6. If it was difficult to identify the correct location of the U-bolts on the "L" cross arm and drill the holes for the U-bolts (Step 2), drill them now.

7. Install the two U-bolt assemblies complete with washers, lock washers and 7/16 in nuts. On one U-bolt assembly, install the ground lug with the braided copper ground wire and pipe clamp, under the washer. Tighten each bolt firmly using a 7/16 in deep socket.

3.3.3.2 Wind Sensor Installation

Tools and materials: UV-resistant tie-wraps, 5/16 in nut driver,1/8 in flat-blade screwdriver, climbing harness, socket wrench, 7/16 in deep socket, diagonal cutters, 3/16 in Allen wrench, compass, solar noon alignment tool

CAUTION

The wind sensor is a highly accurate precision device with NO moving parts. The distance between the three transducer arms is extremely critical. Do not drop the sensor or hang items from it during the installation process. If the sensor is dropped, it must be returned to the manufacturer for repair, even if no damage is apparent.

1. Unpack the wind sensor container K2 (12 in x 12 in x 20 in) containing the 425AHW Wind Sensor, connecting cable, mounting cup w/hose clamp, and a bag of bird spikes, see figure 6.

Figure 6: Wind Sensor with Bird Spikes

2. Save the pre-formed foam packaging for later use.

3. Document the 425AHW Wind Sensor serial number on the Engineering Management Reporting System (EMRS) report form and Installation Checklist.

4. Unpack the wind sensor arm container K3 (6 ft 2 in x 9 in x 4 in) containing a 6 ft wind sensor arm with mounting hardware [6 U-bolts with washers (2), lockwashers (2), 7/16 in nuts (2), and square retaining bracket], see figure 7.

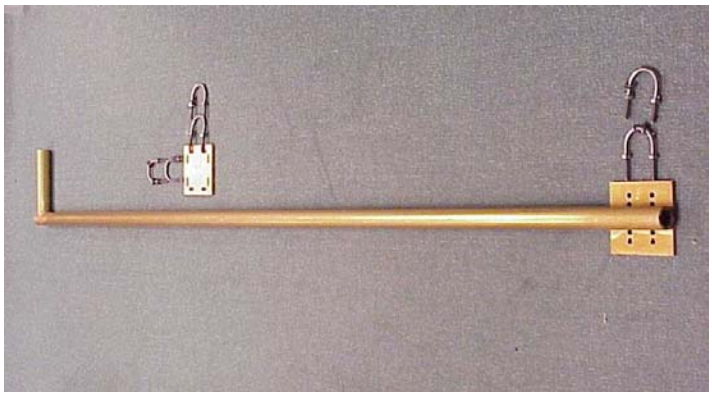

Figure 7: Wind Sensor Arm with Mounting Hardware

5. Identify the appropriate height on the tower where the wind sensor mounting arm will be installed. The height is measured at the orange transducers on the sensor arms. Wind sensors must be mounted on a tower between 6.00 and 10.00 m (19.7 ft and 32.8 ft) above the ground. The downwind distance between the wind sensor and any obstruction must be at least 6 times the height of the obstruction. The siting of the wind sensor upwind of an obstruction can be twice the height of the structure. Wind equipment should be located outside this zone of influence. Ensure the wind sensor is mounted within the protected 60° cone below the tip of the lightning rod (or apex of the tower).

6. Place the square retaining bracket against the mounting arm and place the two U-bolt assemblies, complete with washers, lockwashers, and 7/16 in nuts on the bracket. Do the same with the fixed mounting bracket. Tighten the nuts to secure the U-bolts and brackets.

7. Identify the wind sensor mounting cup and remove the hose clamp from the lower shaft of the cup.

8. Identify the wind sensor cable and push the black plastic connector through the lower shaft of the wind sensor mounting cup. Leave about 15 cm (6 in) between the connector and the top edge of the wind sensor mounting cup. Place an appropriate sized tie-wrap around the cable and through the hole in the upper cup and snug the tie-wrap so the cable will not move. Hold the cable up to the top of the vertical notch in the lower shaft of the wind sensor mounting cup.

9. Place the hose clamp over the shaft of the wind sensor mounting cup and up to the large horizontal notch. Place the lower shaft of the wind sensor mounting cup over the

short vertical tube on the tubular wind cross arm. Tighten the hose clamp using a 5/16 in nut driver or flat blade screwdriver.

10. Using appropriately sized tie-wraps, fasten the wind sensor cable to the tubular wind cross arm. Leave a drip loop just below the wind sensor. Failure to fasten the cable to the cross arm will result in connector failure from the cable weight.

11. Identify the wind sensor bird spikes. Place one on each arm and in the center of the wind sensor. The spike for the center of the sensor is “male." Finger tighten all four spikes.

12. Assemble the wind sensor alignment tool by placing the rod in the stand-off and hand tighten. Note the current time with reference to Solar Noon as determined in Appendix C, *OBTAIN SOLAR NOON*.

13. Climb the tower or use a bucket truck to access the installation location on the tower.

CAUTION

Do not climb the tower or use heavy equipment such as a bucket truck without proper training and appropriate harness equipment.

14. Place the tubular wind cross arm in the indicated location and hold in place using heavy tie-wraps.

15. Loosen the U-bolt nuts from Step 4 enough to slide the square retaining brackets to the vertical legs of the tower where the cross arm will be mounted. Place the two additional U-bolts over the vertical legs of the tower through the square retaining bracket and install a washer, lock washer, and 7/16 in nut on each clamp end. Tighten each bolt firmly using a 7/16 in deep socket.

16. Remove the Allen-keyed screw from the bottom of the wind sensor. Push the cable and connector down into the wind sensor mounting cup until the wind sensor alignment tool seats in the mounting cup. Align the hole in the wind sensor mounting cup to the threaded hole in the wind sensor alignment tool and place the Allen-keyed screw from the wind sensor into the alignment tool. Finger tighten the screw and turn an additional 1/4 turn using a 3/16 in Allen wrench.

17. Using a compass, identify magnetic north. Loosen the hose clamp from Step 7 using a 5/16-inch nut driver. Align the north/south arms to magnetic north. If the declination of true north is known, include that value in the alignment. At this time, other sections of these installation procedures can be followed until it is time to perform the solar noon alignment of the wind sensor.

18. Twenty-five minutes prior to Solar Noon, place the solar noon alignment tool on the wind sensor. Verify that north and south arms of the sensor are correctly placed in the tool and north is approximately aligned. North (N), south (S) and east (E) are marked on the sensor head. Using the compass, identify magnetic north. Loosen the hose clamp on the cup holding the sensor using the 5/16 in nut driver. Align the north/south arms to magnetic north. If the declination of true north is known, include that value in

this preliminary alignment. A shadow must be present on the tool from the rod to continue with this procedure. (If there is not enough sun to cast a shadow, refer to ASOS STM 4.5.2.5 for the full procedure for Solar Noon wind direction sensor alignment to supplement this procedure).

19. Twenty minutes before Solar Noon, check the shadow cast on the tool. The shadow should be visible at 5° West. Starting 20 minutes before solar noon, the shadow will move clockwise (east) 1° (4 minutes = 1° E). The sensor is correctly aligned if 10 minutes prior to Solar Noon, the shadow is 2.5° on the West side of the alignment tool. At solar noon, the shadow should project directly upon the North line of the alignment tool.

20. Tighten the hose clamp (Step 16) using the 5/16 in nut driver.

21. Remove the Allen screw from the bottom of the wind sensor alignment tool. Retain the screw for Step 21 and properly store the wind sensor alignment tool.

22. Connect the black plastic connector on the base of the wind sensor. The connector is keyed - DO NOT force the connection. Finger tighten.

23. Insert the Allen screw into the bottom of the wind sensor. Align the hole in the wind sensor mounting cup to the threaded hole in the wind sensor and replace the Allen screw. Finger tighten the screw and turn an additional 1/4 turn using a 3/16 in Allen wrench.

24. Continue to secure the wind sensor cable along the tubular wind cross arm and down the tower using appropriately sized tie-wraps. Leave the end of the cable up and out of the way until the RPU enclosure has been installed.

3.3.3.3 RPU Installation

Tools and materials: Variable-speed drill, 5/16 in drill bit, 7/16 in open-end wrench, socket wrench, 9/16 in deep socket, 5/16 in nut driver, UV-resistant tie-wraps, 1 in Liquitite non-metallic conduit, 14 ga 2-wire solid copper wire, green shrink wrap, heat gun, 1/8 in flat-blade screwdriver, deep single gang covered outlet box, electrician’s putty, torque wrench

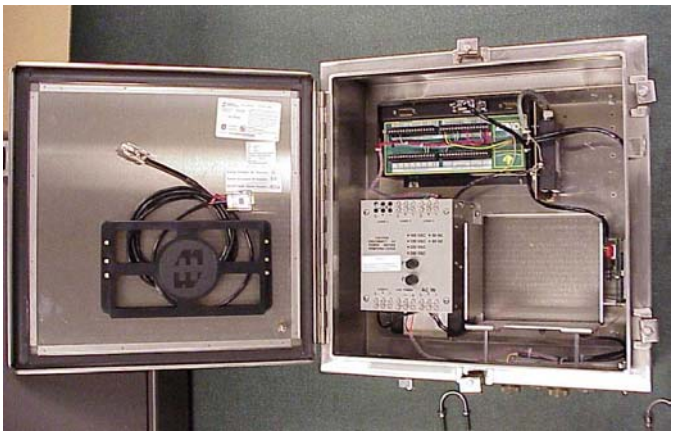

Figure 8: RPU Open Cabinet

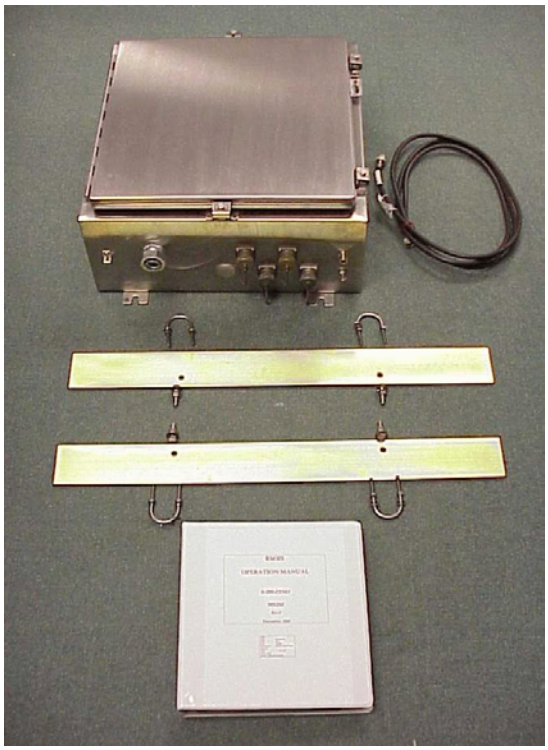

Figure 9: RPU Closed Cabinet with Mounting Hardware

1. Unpack the (30 in x 24 in x 13 in) stainless steel RPU enclosure box (K4) containing the NEMA 4 stainless steel enclosure, mounting brackets (*with 5/16 in bolts, washer, lock washer, and nut*), U-bolts *(washer, lock washer, and 7/16 in nut*), antenna cable, 10 ft RS-232 technician's cable and manufacturers's operation manual. Gently place the enclosure on cardboard or a sheet of bubble wrap until it is to be mounted on the tower.
2. Identify the cabinet mounting plates and correct the location of the U-bolts on plates to fit the tower. The pre-drilled cabinet holes will be up (ƒ) on the lower plate and down („) on the upper plate. Drill holes for the U-bolts using a 5/16 in drill bit. (A template may need to be used on the tower at the point of installation.)
3. Note the serial number and primary and secondary ID numbers on the EMRS report form, CD509, and Installation Checklist. (The RPU and SDL serial numbers should be the same.)

NOTE: If the radio will be used in temperatures below -30°C, a heater must be installed.

4. If appropriate, install a heater. Attach the glue side of the RPU Assembly Heater (ASN S200-1A1RT1HR1) under the radio mounting plate and connect the two red wires to

the line and neutral of LOAD FOUR (a.k.a. SWITCHED POWER 120VAC) on the RPU power supply. Secure the wires using appropriately sized tie-wraps (S4).

5. Close the enclosure and tighten the door using a 7/16 in open end wrench (T14). Place the enclosure face side down on the sheet of bubble wrap.

6. Attach the upper RPU Enclosure mounting plate to the rear upper mount of the enclosure using the 5/16 in bolts. The bolts should be installed from the front with a washer. Secure the bolts at the rear with a washer, lock washer, and nut. Tighten firmly with a 9/16 in deep socket.

7. Attach the lower RPU Enclosure mounting plate to the tower using two U-bolts. Level and tighten firmly. Install the two remaining bolts from the front with a washer, and from the rear, with a washer, lock washer, and nut. Leave the bolts as loose as possible.

8. Lift the RPU Enclosure to the lower enclosure mounting plate installed in Step 7. Place the open slots on the rear lower mount of the enclosure over the bolts behind the washer firmly, pressing the cabinet back against the tower so that the upper part of the RPU Enclosure is flush against the upper mounting plate. Firmly tighten the 5/16 in bolts attaching the RPU Enclosure to the lower mounting plate.

9. Push the two 5/16 in bolts, one at a time, through the upper RPU Enclosure mounting plate and install a washer, lock washer, and 5/16 in nut on each. Firmly tighten the 5/16 in bolts attaching the RPU Enclosure to the upper mounting plate. Firmly tighten the 5/16 in bolts attaching the RPU Enclosure to the lower mounting plate.

10. Open the RPU Enclosure (which was closed in Step 5) using a 7/16 in open end wrench.

11. Find the grounding lug at the base of the tower. Install braided copper ground wire from the grounding lug to the ground lug on the bottom left of the enclosure. Remove any corrosion on the ground lug to ensure a good contact at the base of the tower. Dress the ground wire with tie-wraps as necessary.

12. Measure and cut the appropriate length of 1 in Liquitite non-metallic conduit and 14/2 solid copper wire. DO NOT “short-lead” the 14/2 copper wire. Feed the wire through the conduit and then strip and trim each end.

13. Remove the 1 in conduit feed-through nut, plastic washer and compression fitting from the RPU enclosure. Place the nut and plastic washer over the Liquitite conduit, and insert the compression fitting. Screw the assembly into the enclosure.

14. Place green shrink wrap over the ground. Shrink it using heat gun or another approved method.

15. Loosen the input power screws (marked AC POWER IN) using a 1/8 in flat blade screwdriver. Insert the black wire to (L), the white wire to (N), and the now covered ground wire to ground. Firmly tighten all screws.

16. Locate the circuit breaker for the outlet box/power at the tower base. Turn OFF power and “Lock-Out” the breaker prior to any further wiring of the RPU enclosure.

17. Remove the GFI receptacle from the covered deep single-gang outlet box with three 1 in threaded holes. Place a 1 in conduit feed-through nut and plastic washer over conduit and insert the compression fitting. Screw the base into the outlet box and feed the wire through. Wire the enclosure to the LOAD side of the GFI connector. Replace the GFI connector in the receptacle and restore the outlet box.

18. Use electrician's putty in the cabinet around the input power cable to the RPU enclosure to prevent moisture intrusion.

CAUTION

DO NOT turn the power back on.

19. Close the enclosure and tighten the door using a 7/16 in open end wrench. Continue installation of the remaining RSOIS components.

3.3.3.4 Directional Antenna Installation

Tools and materials: Socket wrench, 7/16 in deep socket, 5/16 in nut driver, self-vulcanizing (Scotch 70 type) tape, UV-resistant tie-wraps

Figure 10: Directional Antenna Components

1. Unpack the Directional Antenna box K5 (19 in x 6 in x 4 in) containing the Yagi Antenna with mounting hardware [*(2) U-bolts with washers and locknuts, (2) brackets, and (1) flat mounting plate*], manual and warning sticker.

2. The antenna should be installed approximately 3.05 m (10 ft) above the bottom of the enclosure using the provided U-bolts, flat washers, clamps, and nuts as shown in figure 10.
3. Place one U-bolt over the tower (or mast), then place one mounting bracket (notched side toward the tower) over the U-bolt.
4. Place and align the backing plate to the back flat side of the antenna housing and place the assembly on the U-bolt as shown figure 10, with arrows on the antenna housing facing up (8).
5. Loosely install the flat washers and locknuts.
6. Place the second mounting bracket notched side toward the tower (or mast) between the tower and backing plate. Push the second U-bolt over the tower and through the notched mounting bracket, flat mounting plate, and antenna.
7. Loosely install the flat washers and locknuts.
8. Point the antenna toward the Base Station antenna. Orientation accuracy should be within ± 15° to achieve maximum gain.

CAUTION

Do not exceed 45 inch-pounds of torque on nuts and screws.

9. Tighten all four locknuts securely. Do not over tighten.
10. Connect one end of the antenna cable to the antenna connector/cable and wrap it with self-vulcanizing (Scotch-70 type) tape.
11. Connect the other end of the antenna connector/cable to the antenna connector on the RPU enclosure and wrap it with self-vulcanizing (Scotch-70 type) tape.
12. Secure the antenna cable to one leg of the tower (away from the sensor cables) with a tie-wrap.

3.3.3.5 Temperature/Humidity Unit

Tools and material required: Socket wrench, 7/16 in deep socket, 5/16 in nut driver, 1/8 in flat-blade screwdriver

1. Unpack the Temperature/Relative Humidity Sensor box K6 (3 ft 10 in x 12 in x 10½ in) containing the Temperature/Relative Humidity Sensor with aspirator, see figure 11, connector and mounting hardware (*2 U-bolts with washers and locknuts*).

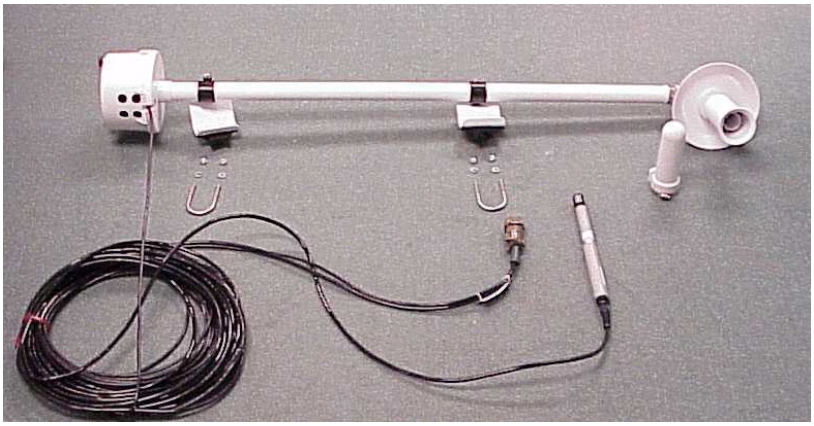

Figure 11: Temperature/Humidity Unit Components

2. Identify the appropriate height on the tower where the aspirated shield cross arm assembly (included with K6) will be installed. The height of the sensor is measured at the bottom of the sensor aspirator intake. The temperature/RH sensors must be securely mounted on the tower between 1.25 and 2.00 m (4.10 ft and 6.56 ft) above the grass covered ground. Stations with significant snow depth accumulations shall mount the temperature and RH sensor 1.25 to 2.00 m (4.10 ft and 6.56 ft) above the worst month average snow depth. An acceptable site shall be over level ground, freely exposed to sunshine and wind, and not shielded by or close to obstructions such as trees and buildings. The sensing arm should be level to within two degrees of horizontal and have an approximate East to West orientation with the sensing element on the West side.

NOTE: If the aspirated shield is fully assembled, proceed to Step 9. If not assembled, complete steps 2 through 8.

NOTE: The standard 43408 Gill Aspirated Radiation Shield is normally supplied with a threaded plug for holding the temperature sensor, junction box, and split bushing. The junction box provides terminals for cable connections and properly positions the sensor within the shield assembly.

3. Thread the shield assembly into the appropriate threaded opening in the shield mounting tee at the end of the telescoping arm. Tighten the shield by hand, being careful not to cross-thread or over tighten.
4. Place the band clamp over the top of the shield mounting tee.
5. Insert the sensor into the shield mounting tee, adjusting the position of the sensor tip if necessary. Position the sensor so that its tip will be 7.0 cm (2.75 in) from the bottom opening of the intake tube. Refer to the *RSOIS Operation Manual*, Sensor Manual section, “Section View of the Temperature Shield” drawing. Readjust as necessary;

improper installation may block the airflow, causing errors in measurement and the fan fail Bit to be set.

6. Tighten the threaded split bushing to secure the probe in place. Do not over tighten.

7. Place the probe top cover over the top of the probe/cable. The strain relief on the cable can be bent all the way to accomplish this. The probe top cover should rest inside the band clamp and the cable should feed through the channel.

8. Tighten the band clamp securely.

9. Install the Temperature/Relative Humidity Sensor assembly using the bolts from the pre-installed mounting bracket assemblies with a 7/16 in deep socket. Do not over tighten.

10. Tighten the pre-installed mounting brackets loosened in Step 5. Do not over tighten.

NOTE: Attach the aspirator so that the mounting arm is horizontal and the blower exhaust vents are facing down.

11. Loosen the band clamp holding the telescoping mounting arm using the 5/16 in nut driver or flat blade screwdriver.

12. Extend the arm so that the shield intake is at least 60 cm (24 in) from the tower. Adjust the shield so the intake opening is facing vertically downward. Tighten the band clamp from Step 11 using the 5/16 in nut driver. At relative humidity above 97% the technology tends to diverge and values for relative humidity may indicate 100%. Experience with each individual sensor will provide interpretation of these values.

3.3.4 Connections and Power-on

Tools and materials: Self-vulcanizing (Scotch 70 type) tape, pliers, dielectric compound, UV-resistant tie-wraps, 7/16 in open-end wrench

1. Connect the RPU antenna cable to the UHF connector on the far right bottom of the RPU enclosure. Once the antenna (or antenna cable) has been connected, the UHF connector should be wrapped and sealed in self-vulcanizing (Scotch-70 type) tape.

2. Connect the aspirated shield assembly connector to the front right “military-type” connector. ALL connectors are keyed - DO NOT force the connector. Finger tighten and turn an additional 1/4 turn using pliers.

3. Connect the wind sensor connector (1-wire) to the front left “military type” connector. ALL connectors are keyed - DO NOT force the connector. Finger tighten and turn an addition 1/4 turn using pliers.

NOTE: In damp or salty regions, it may be appropriate to use a dielectric compound on RSOIS pin connections, and a material such as Dow Corning’s G-N Metal Assembly Paste® on threads.

4. Dress and secure ALL cables using tie-wraps.

5. Open the RPU Enclosure and inspect all connections for compliance with this procedure.

6. Unpack the RPU Battery box K7 (8½ in x 7½ in x8 in) containing the lead acid battery and connecting hardware.

7. Install the lead-acid battery, see figure 12, on its tray in the RPU enclosure. The battery should be upright with the identifying labeling and terminals facing out and the POSITIVE (+) terminal on the right.

Figure 12: RPU Battery and Connecting Hardware

CAUTION

Prior to connecting the battery leads, make sure the antenna is connected to avoid damage to the radio. Once the battery leads are connected, the system is ON.

8. Connect the positive lead (white), then the negative lead (black) to the appropriate ring lugs on the battery terminals with the hardware provided.

9. Place the provided packets of desiccant (Desiccant D25-3, ASN S200-1A1DES) into the enclosure.

10. Close the RPU enclosure and tighten the door using a 7/16 in open end wrench.

3.4 Communications, Data, and Configuration

3.4.1 Procomm Setup

Installation of Procomm (or a terminal program such as Windows Terminal) is required for system setup, initialization, and configuration changes. NWS sites should install Procomm Version 4.7 (S100-TE318-2), then follow the instructions in Appendix D, *PROCOMM SETUP*. (They can also be applied for other common terminal programs.)

3.4.2 Base Station ID Setup

The BS and RPU are equipped to communicate with each other by data radio. It is essential to properly configure the BS so that it will properly receive data transmissions from the RPU. Follow the steps in Appendix E, *BASE STATION SETUP*.

3.4.3 Terminal Communications

Communications with the RSOIS can be established via a laptop computer at the System Data Logger via COM3 using the dedicated terminal cable, the fiber optic modem using the dedicated terminal cable, or directly through the BS radio. Any communication package may be used - NO proprietary software is required. The Zeno®-3200 User Manual adequately describes the basic procedures. The RSOIS interface is not case sensitive.

1. Set the communication parameters of the computer to 9600 baud, 1 start bit, 1 stop bit, 8 data bits and parity to NONE.
2. Upon connecting the terminal cable to the RSOIS via any method, there will be broadcast data.
3. To set up the BS radio, connect the BS dedicated RS-232 to a properly configured PC or laptop with the communications package open. (A desktop PC is preferred).
4. Ensure that the BS antenna (left hand threads) is connected, then turn the BS ON. The POWER light on the BS will illuminate and the DATA light should illuminate approximately every five (5) seconds. If so, go to section 3.4.4. If NOT, continue to Step 5.
5. If the DATA light does not flash approximately every five (five) seconds, turn the BS OFF, wait 10 seconds, and turn it back ON. If the light still does not flash, return BS to NRC for repair. If BS DATA light begins flashing, go to section 3.4.4.

CAUTION

To avoid damage to the BS radio, never plug the unit into 115 VAC while in the ON position. Never turn ON the unit without the antenna attached.

3.4.4 Base Station and RPU Communication Link Setup

The BS and RPU are equipped to communicate with each other by radio. When the RPU is connected to a workstation PC via fiber optic cable, both radio and fiber optic links may be used concurrently. Software configuration changes will not be required to switch between the two modes.

CAUTION

Be sure to disconnect power to the BS and RPU (and battery) while making any of these changes to them. Failure to do so may cause permanent damage.

To operate the data link via radio, verify:

1. The radio data modem in the RPU is connected to the SDL by the cable supplied with the RPU. This cable has a standard DB-25 connector that should be attached to the "AUX SERIAL DATA" connector located on the front panel of the Zeno®-3200. This cable supplies both power and data.
2. Respective antennas are connected to the BS and RPU.

CAUTION

Connection of an improper antenna may cause damage to the radio.

Once the proper connections are made and verified, the RPU and BS may be powered. Within a minute, the RPU should be collecting and transmitting data. Likewise, the display on the BS should activate within a minute. The "DATA" indicator lamp on the BS should light for about a second every five seconds. Within a few transmissions, the first data should be displayed. Until the sensors have collected enough valid data, "999" may be displayed in place of actual sensor readings. The data being displayed on the BS's LCD will also be echoed on the BS's serial port. If the data is not being displayed on the BS's LCD but is being received through the BS's serial port, then the BS has not been configured to display the data from, the RPU. Refer to Appendix E, *BASE STATION SETUP*, for BS setup instructions.

To communicate with the RPU remotely, through the BS, follow the instructions in Section 3.4.6, Remote Access to the RPU.

To operate the data link via fiber optic modem, verify:

1. The fiber optic cable is connected to the fiber optic modems in the RPU and the PC workstation. Follow the steps in Appendix P, Installation of Fiber Optic Cable and Modem.

2. The fiber optic modem at the workstation is connected to the serial port of the PC.

3. The workstation fiber optic modem is connected to a power source.

Start communication interface software (i.e. Procomm or Hyper Terminal).

3.4.5 The Base Station Display

The BS display is updated every five to six seconds and provides current wind, temperature, dew point and humidity conditions at the RPU enclosure installation point. Below is an example of the Radio BS display.

ID:	11				
SP:	9	**WD:**	360	**AT:**	24.4
GU:	0	**WC:**	0	**DP:**	-2.5
PK:	12			**RH:**	16.0

ID: System Identification Number (or BS Secondary ID)
SP: Current 2 minute average wind speed [WS] (± 3 %)
GU: Gust Speed - Maximum WS in the last 10 minutes
GU: <*Value*> * - An asterisks (*****) is placed to the right of the gust speed value indicates a possible **Squall** condition. (*Alert Condition*)
PK: The maximum 5 second WS from the sensor in the last 2 minutes (*within the period represented by **SP***)
PK: <*Value*> * - An asterisks (*****) is placed to the right of the Peak WS Value indicates a possible NWS **reportable** peak WS.(*Alert Condition*)
WD: Current 2-minute average wind direction [WD] in degrees (± 2°)
WC: 0 = Steady WD, 1 = Variable WD
AT: Current 5 minute average temperature in degrees Celsius.(± 0.5°C)
DP: Current 5 minute average dew point temperature in degrees Celsius.(± 2.0°C)
RH: Current 5 minute average relative humidity by percent (± 3 %)

3.4.6 Remote Access to the RPU

The RPU may be accessed remotely through the BS's serial port. This allows an operator at the BS to perform some routine maintenance without physical access to the RPU.

In order to facilitate remote access, the BS has a mode called "terminal pass-thru mode." Follow the instructions to enter this mode. Once in terminal pass-thru mode, enter the RPU's menu system by issuing standard Zeno® commands. The commands will be sent via the active communications link (radio or fiber optic cable). Responses from the RPU will be received by the BS and then echoed on the BS's communication port. In this way, the remote communication appears transparent during the terminal pass-thru mode session. When finished communicating with the RPU, exit pass-thru mode so that the BS can resume normal operations.

To establish remote communication with the RPU, set up Procomm or other serial communications package following the instructions in Appendix E, *BASE STATION SETUP*,

establish an RS-232 serial connection with the base station, and then follow the installation checklist in Appendix L, *BS AND RPU CONFIGURATION UPLOAD*.

NOTE: When finished communicating with the RPU remotely, you should completely exit the RPU's menu system before exiting the BS's "terminal pass-thru mode."

3.4.7 User References

User reference material is contained in the following appendices:

Appendix F Saving BS Configuration Files
Appendix G Saving RPU Configuration Files
Appendix H Data Retrieval
Appendix I Wind Sensor Communication and Interrogation
Appendix J Changing System Time
Appendix K Checking RPU Data
Appendix L BS and RPU Configuration Upload

4. MAINTENANCE

4.1 Preventive Maintenance Schedule

The RSOIS system is designed for long-term, unattended operation and is almost completely maintenance free. Preventive maintenance is important, however, because it extends component service life and prevents untimely system downtime by routinely replacing worn parts before they fail. Preventive maintenance should be performed in accordance with the following schedule.

Table 3: Preventive Maintenance Schedule

Inspection	Service	Interval (months)	Procedure Section
Tower Inspect all cables on the tower for condition and tautness.	Collect loose cable together at the bottom of the RPU cabinet; maintain drip loops; secure every 3 feet.	6	4.2.1
Inspect all tie-wraps for wear/damage or brittleness from UV exposure.	Replace worn tie-wrap.	6	4.2.1
Inspect tower sections, joints, hinges, etc. for corrosion or other damage.	Clean and lubricate; replace if necessary. See tower documentation for supplementary guidance	12	4.2.1
Inspect threaded anchors for damage; ensure bolts are secure.	Tighten; replace hardware if necessary.	12	4.2.1
Inspect guy wires for tautness, fraying, or other damage.	Tighten; replace wires if necessary.	12	4.2.1
Verify that the tower is plum within 2° of vertical.	Loosen and readjust; shim if necessary.	12	4.2.2
Inspect the lightning and grounding components for damage and verify security. The earth ground should be according to local code or 25 ohms or less. Items on the tower should be protected in a 60° cone below the tip of the lightning rod.	Ensure conformance to installation procedures.	12	4.2.3

Inspection	Service	Interval (months)	Procedure Section
Remote Processing Unit Inspect the enclosure, door hinge, fittings, and connectors for damage or corrosion.	Clean and lubricate with dielectric compound; replace desiccant; replace enclosure if necessary.	6	4.2.1
Inspect the rubber gasket for wear or deterioration.	Clean with mild soap and water; rinse thoroughly. Replace enclosure if necessary.	6	4.2.1
Inspect the battery and terminals for damage, corrosion, and tightness.	Clean with mild soap and water; rinse thoroughly.	6	4.2.1
Inspect the fiber optic driver for damage (the green transmit light should illuminate periodically).	Replace fiber optic driver if necessary.	6	4.2.1
Inspect the power supply for damage or corrosion.	Replace power supply if necessary.	6	4.2.1
Inspect the antenna cable from the radio to the connector in the enclosure for tightness, condition, lubrication, and security of the self-fusing tape.	Clean, replace tape, and tighten as required. Replace antenna cable if necessary.	12	4.2.1
Directional Antenna Inspect the directional antenna for secure mount and protective shell integrity.	Replace antenna if necessary.	12	4.2.1
Temperature/Humidity Unit Inspect the HMP45D filter. (More frequent inspection may be appropriate in some locations)	Replace filter as required.	2	4.2.1
Inspect the blower motor for condition and operation.	Clean; replace blower motor if required.	6	4.2.1
Inspect the cable and connector for condition, tightness, and lubrication.	Clean and lubricate with dielectric grease; tighten appropriately; replace HMP45D if required.	6	4.2.1
Inspect mounting brackets, clamps, and U-bolts for tightness.	Tighten; replace hardware if necessary.	12	4.2.1

Inspection	Service	Interval (months)	Procedure Section
Inspect the mounting adapter and split bushing for condition.	Replace hardware if necessary.	12	4.2.1
Inspect the HMP45D for damage.	Replace HMP45D if necessary,	12	4.2.1
Inspect the complete aspirated shield assembly; ensure that the skirt/shield, top cap/cover, and the blower assembly are not cracked or clogged.	Clean, repair, and/or replace aspirated shield assembly as required.	12	4.2.1
Compare the AT/RH sensor to local standard.	Replace HMP45D if necessary.	12	4.2.4
Replace the HMP45D AT/RH probe.	Remove the HMP45D AT/RH probe; replace with a calibrated probe.	24	4.2.4
Wind Sensor Inspect the wind sensor for damage to the shell or protective rubber over the transducers.	Replace wind sensor if necessary.	6	4.2.1
Inspect the 425AHW using the margin verifier and SDL pass-thru mode.	Perform procedure.	6	4.2.5
Inspect the wind sensor mounting hardware for security.	Tighten as required.	12	4.2.1
Verify that the sensor's orientation is within 1 degree of true north and within 2 degrees of horizontal.	Adjust and align as required.	12	4.2.6
Inspect the wind sensor bird spikes for damage.	Tighten as required; replace bird spikes if necessary.	12	4.2.1
Inspect the wind sensor mounting cup for damage; verify that the sensor is properly seated and that the securing screw is tight.	Adjust, align, and tighten as required.	12	4.2.1

Inspection	Service	Interval (months)	Procedure Section
Base Station Inspect complete unit for damage or corrosion.	Clean; replace BS if necessary.	24	4.2.1
Inspect the antenna for cuts and wear and the connector for burrs, other damage.	Replace antenna (left hand threads) if necessary.	24	4.2.1
Inspect the power cable for cuts and wear.	Replace power cable if necessary.	24	4.2.1
Inspect the terminal cable for cuts and wear and the connector for burrs, other damage.	Replace terminal cable if necessary.	24	4.2.1

4.2 Preventive Maintenance Procedures

4.2.1 Inspection, Cleaning, and Lubrication

Inspect cables, connectors, and equipment surfaces for tightness, wear, corrosion, and dirt. Tighten connections as required. Clean using mild soap and water; lubricate with dielectric compound.

4.2.2 Tower Alignment

Vertical alignment of the tower can be verified and corrected following procedures in tower installation documentation.

4.2.3 Lightning and Grounding Components

Verify correct installation in accordance with Section 3.3.2, Verifying Site Ground Resistance and Section 3.3.3, System Installation.

4.2.4 Temperature/Humidity Sensor Replacement

Biennial calibration of the temperature and humidity probes at the designated depot require sensor removal and replacement. Remove the sensor and replace it with a calibrated sensor by following the steps in section 4.3.3.

4.2.5 Wind Sensor Accuracy Test

Periodic testing detects slow deterioration of the sensor before it significantly affects accuracy. The periodic test uses the margin verifier (Handar 425-7010), a small echo-free chamber with built-in 10 dB sonic attenuator in each of the three sonic paths, see figure 13.

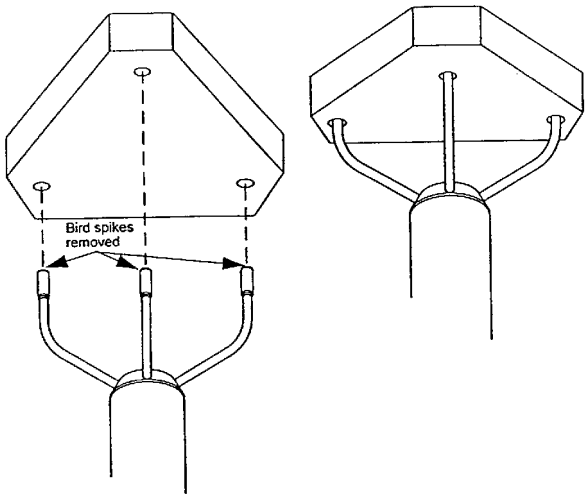

Figure 13: Margin Verifier

Tools and materials: Margin verifier (ASN: S200-1A3AT1)

The test consists of the following steps:

1. Unscrew and remove the bird spikes.
2. Slip the margin verifier over the three transducers and cover with cloth bag supplied with margin verifier.
3. If the sensor reads less than 0.5 mph, remove the margin verifier and replace the bird spikes.
4. If the sensor reading is 0.5 mph or more, replace the one or more of the bird spikes, repeating the accuracy test as necessary to confirm sensor accuracy.
5. If the sensor reading is 0.5 mph or more after replacing the bird spikes, replace the wind sensor assembly following the procedure in section 3.3.3.2.

4.2.6 Wind Direction Alignment

Procedures for aligning the wind sensor are contained in section 3.3.3.2.

4.3 Corrective Maintenance

Field level corrective maintenance consists of fault detection and isolation, replacement of failed field replaceable units (FRU) and cabling, and post-repair performance verification testing.

Replaced items are either returned to the National Reconditioning Center (NRC) for repair or disposed of locally as determined by source, maintenance, and recover ability (SMR) codes in NWS EHB-1, Instrumental Equipment Catalog.

4.3.1 Fault Detection

The system runs a continuous built-in-test (BIT) to verify operation of all sensor and SDL hardware. These self-tests are designed to detect abnormal operating conditions; applicable BIT flags are listed below. Refer to Appendix K, *CHECKING RPU DATA*, for directions on how to check the BIT flags status.

Table 4: BIT Flags

BIT Number	Hex Bit Message	Description	Condition
1	0000 0001	Zeno®-3200-Reset	As shown in the Zeno® Manual
2	0000 0002	Real-Time-Clock-Suspect	
3	0000 0004	Logging-Memory-Initialized	
4	0000 0008	Serial-Sensor-COM-Failure	
5	0000 0010	EEPROM-Suspect	
6	0000 0020	18-Bit-ADC-Suspect	
7	0000 0040	12-Bit-ADC-Suspect	
8	0000 0080	Temperature-Clock-Adjustment	
9	0000 01xx	Air temperature invalid average	< 75% of the samples valid in the running average.
10	0000 02xx	Air temperature out of range	AT > 70°C or < - 60°C
11	0000 04xx	Air temperature static	No change in 30 minutes
12	0000 08xx	Aspirator air flow malfunction	Aspirator air flow switch alarm
13	0000 1xxx	Relative humidity invalid average	< 75% of the samples valid in the running average

BIT Number	Hex Bit Message	Description	Condition
14	0000 2xxx	Relative humidity out of range	100% < RH < 105%
15	0000 4xxx	Relative humidity out of range	RH > 105% or< 0
16	0000 8xxx	Relative humidity static	No change in 30 minutes
17	0001 xxxx	Wind invalid average	< 75% of the samples valid in the running average
18	0002 xxxx	Wind speed average out of range	WS > 125 or < 0
19	0004 xxxx	Wind speed static > 600 seconds	No change in 10 minutes
20	0008 xxxx	Wind sensor heater off	As flagged from the sensor
21	0010 xxxx	Internal temperature check	Internal temperature < - 28°C
22	0020 xxxx		

Off-line diagnostic procedures are available from external commands received via laptop computer connection to the serial maintenance interface of the system. Off-line diagnostic procedures and specialized software tools to detect faults not detected by the built-in test (BIT) are provided with the system.

4.3.2 Troubleshooting Procedures

No wind data:

- Check the wind sensor cable.
- Check the wind sensor by using SDI-12 pass thru mode. Use the commands listed in Appendix I, *WIND SENSOR COMMUNICATION AND INTERROGATION*, and compare results with the examples shown in Appendix I.
- Check the RPU Sensor configuration. Make sure Item 17 for Sensors 2 and 3 are both set to “0"
- Check the 1.0K ohm resistor on the Zeno 3200 data logger between COM 2B and RTN.
- Visually inspect the wind sensor.
- Disconnect the wind sensor connector from the RPU (the "military type" connector with only one set of wires) , wait 10 seconds, then reconnect the wind sensor. If this does not work, turn off AC power and disconnect the battery at the RPU, wait 10 seconds, then reconnect the battery and turn the AC power back on.

No wind sensor heater:

- Ensure the AC power is ON.
- Check fuses F1 and F3 on the power distribution module.
- Check the wind sensor cable.
- Check the wind sensor heater by using SDI-12 pass thru mode. Use the commands listed in Appendix I, *WIND SENSOR COMMUNICATION AND INTERROGATION*, and compare results with the examples shown in Appendix I.
- Check the power to the wind sensor heater at the orange connector on the power distribution module between GND and P1. It should be 36 - 40 vdc.
- Visually inspect the wind sensor.

No air temperature data:

- Check the AT/RH cable.
- Disconnect the AT/RH cable from the RPU, then check the resistance across the 4.99 K ohm resistor between CH 7- and AGND on the Zeno 3200 data logger.
- Measure the resistance between pins D and E of the disconnected 10 pin male MS connector. Convert the resistance to temperature by using the chart in Appendix O, *RESISTANCE VS. TEMPERATURE CHART*, then compare the result with local temperature standard.
- Visually inspect the AT/RH sensor.

No relative humidity data:

- Check the AT/RH cable.
- Disconnect the AT/RH cable from the RPU, then check the voltage between pins A and C of the 10 pin female MS connector underneath the RPU enclosure. It should be 11 - 14 vdc.
- Visually inspect the AT/RH sensor.

No aspirated shield air flow:

- Check the AT/RH cable.
- Disconnect the AT/RH cable from the RPU, then check the voltage between pins G and J of the 10 pin female MS connector underneath the RPU enclosure. It should be 11 - 14 vdc.
- Visually inspect the aspirator blower motor.

Aspirated air flow seems OK, but an error is reported:

- Make sure the AT/RH sensor tip is not blocking the flow of air through the pipe.
- Make sure that the aspirated wind shield assembly is not mounted upside down or sideways.
- Visually inspect the AT/RH sensor.

No charge to the battery:

- Make sure the AC power is ON.
- Check fuses F2 and F3 on the power distribution module.

- Gently and carefully remove the terminals from battery and measure the voltage at the ring lugs; it should be about 13.8 vdc.
- Replace the battery.

Zeno 3200 Data Logger does not power up:

- Check voltage between + POWER and - POWER on the Zeno 3200 data logger.
- Check the fuse located on the bottom of the Zeno 3200 data logger. See section 4.3.3.7 for instructions on fuse removal.

The RPU is not transmitting:

- Make sure the DB-25 connector is tightly connected to the SDL's Aux Serial Data port.
- Make sure the green LED on the radio is ON.
- Cycle the power to the radio by removing the DB-25 connector and plugging it back in to the Aux Serial Data port. Check that one green LED on the radio is ON and the second LED blinks once every five seconds.
- Check the BS for the proper IDs. Make sure that the Primary ID of the BS is the same as the Secondary ID of the RPU, and that the Secondary ID of the BS is the same as the Primary ID of the RPU.
- Check the BS configuration. Make sure that Item 17 for Sensor 2 is the same as the Secondary ID of the BS.
- Make sure that the RPU and BS antennas are line of sight.

BS is not getting data:

- Check the BS for the proper IDs. Make sure that the Primary ID of the BS is the same as the Secondary ID of the RPU, and that the Secondary ID of the BS is the same as the Primary ID of the RPU.
- Check the BS configuration. Make sure that Item 17 for Sensor 2 is the same as the Secondary ID of the BS.
- Make sure that the RPU and BS antennas are line of sight.

4.3.3 Removal and Installation Procedures

The following chart is provided to facilitate safe and efficient removal and replacement of defective Field Replaceable Units. Only those items whose replacement procedures are not obvious are included in this section.

Field Replaceable Unit	Section Reference
RPU Battery	4.3.3.1
RPU Fiber Optic Driver	4.3.3.2
RPU Power Supply Fuses	4.3.3.4
RPU Radio	4.3.3.4
RPU Radio Heater	4.3.3.5
RPU System Data Logger	4.3.3.6

NOTE: Procedures in sections 4.3.3.1 through 4.3.3.7 may entail opening the RPU enclosure. Change the desiccant each time the RPU enclosure is opened.

4.3.3.1 RPU Battery

REMOVAL

1. Disconnect the negative ring terminal (black) from the battery's negative terminal.
2. Disconnect the positive ring terminal (red) from the battery's positive terminal.
3. Remove the battery from its compartment in the RPU enclosure by sliding it over the shelf bracket edge.

INSTALLATION

1. Slide the replacement battery in its compartment making sure that the battery is all the way back and the shelf bracket edge prevents the battery from sliding out. The battery terminals must be facing the top of the enclosure and the information on the battery should be visible from outside the enclosure.
2. Connect the positive ring terminal (red) to the battery's positive terminal.
3. Connect the negative ring terminal (black) to the battery's negative terminal.
4. Place the replaced battery in the replacement battery's package; dispose of the replaced battery in accordance with local environmental safety requirements.

4.3.3.2 RPU Fiber Optic Driver

Tools and materials: "Long" #2 Phillips screwdriver, #1 Phillips screwdriver, ¼ in nut driver

REMOVAL

1. Remove the RPU wiring harness connector and the ST-Type Duplex-Multimode fiber optic cable from the Fiber Optic Driver.
2. Using the #2 Phillips screwdriver, remove the two Phillips screws holding the Fiber Optic driver and mounting plate from the back plate (the Fiber Optic Driver is now free of the RPU Enclosure). Save the removed screws.
3. Using the #1 Phillips screwdriver and a1/4 in nut driver, remove the four screws/nuts holding the Fiber Optic Driver to the mounting plate. Save the screws and nuts.

INSTALLATION

1. Attach the replacement Fiber Optic Driver to the mounting plate using the #1 Phillips screwdriver, 1/4 in nut driver, and four screws and nuts removed in Step 3 above.
2. Attach the mounted Fiber Optic Driver to the back plate using the #2 Phillips screwdriver and the two screws and nuts removed in Step 2 above.
3. Reattach the ST-Type Duplex-Multimode fiber optic cable to the Fiber Optic Driver and replace the RPU wiring harness connector.

4.3.3.3 RPU Power Supply Fuses

REMOVAL

1. Locate the appropriate fuse holder on the labeled face of the RPU Power Supply Module.
2. Using thumb and forefinger, gently press the fuse holder in and turn counter-clockwise until it disconnects from its receptacle.
3. Remove the fuse from the fuse holder.

INSTALLATION

1. Insert the replacement fuse in its fuse holder.
2. Using thumb and forefinger, gently press the fuse holder in and turn clockwise until it seats in its receptacle.

4.3.3.4 RPU Radio

Tools and materials: #1 Phillips screwdriver, (2) 5/16 in open end wrenches, and small side diagonal cutters

REMOVAL

1. Remove the battery following the procedure in section 4.3.3.1.

2. Locate the three recessed Phillips screws on the right side of the battery compartment. Remove the screws using the Phillips screwdriver.
3. Gently pull the radio away from the enclosure wall until the red Zeno®-3200 connector is exposed.
4. Disconnect the Zeno®-3200 connector from the radio.
5. Cut the plastic tie-wrap securing the antenna cable to the radio; disconnect antenna cable.
6. Remove the radio.

INSTALLATION

1. Connect the antenna cable to the radio and secure the cable using a new plastic tie-wrap.
2. Connect the Zeno®-3200 connector to the radio.
3. Position the connected radio so the screw holes in the radio are aligned with the recessed screw holes on the battery compartment.
4. Replace and tighten the three Phillips head screws removed in Removal Step 2.

4.3.3.5 RPU Radio Heater

REMOVAL

Reverse the procedure in Step 4 in section 3.3.3.3.

INSTALLATION

Step 4 in section 3.3.3.3., and Appendix M, *HEATER RELAY TEST*

4.3.3.6 RPU System Data Logger

Tools and materials: Small side diagonal cutters, and Phillips screwdriver.

REMOVAL

1. Cut the plastic tie-wraps securing the radio, fiber optic driver, power supply, and sensor cabling to the Zeno®-3200 side plates.
2. Disconnect the radio cable by loosening the connector thumbscrews and unplugging the connector.
3. Unplug the four terminal boards holding the fiber optic driver, power supply, and sensor cabling.
4. Using a Phillips screwdriver, remove the four screws securing the Zeno®-3200 to the rear wall of the enclosure.
5. Remove the Zeno®-3200, place it in the replacement data logger's package, and return it to the NRC in accordance with normal procedures.

INSTALLATION

1. Using a Phillips screwdriver and the four Phillips head screws, secure the Zeno®-3200 to the rear wall of the enclosure.
2. Plug in the four terminal boards holding the fiber optic driver, power supply, and sensor cabling.
3. Connect the radio cable by plugging in the connector and tightening the connector thumbscrews.
4. Use new plastic tie-wraps to secure the radio, fiber optic driver, power supply, and sensor cabling to the Zeno®-3200 side plates.

4.3.3.7 RPU System Data Logger Power Input Fuse

Tools and materials: 90° offset flat blade screwdriver

REMOVAL

1. Facing the Zeno®-3200, locate the fuse holder on the right bottom of the data logger.
2. Using the offset screwdriver, turn the fuse holder counter-clockwise to release the fuse holder.
3. Remove the fuse from its holder.

INSTALLATION

1. Place a new fuse in the holder.
2. Using the offset screwdriver, turn the fuse holder clockwise to reseat the fuse holder.

4.3.3.8 Temperature/Humidity Unit

REMOVAL

To remove the complete assembly, reverse the installation procedures in section 3.3.3.5.

INSTALLATION

To install a replacement unit, follow the section 3.3.3.5 instructions for initial Temperature/ Humidity Unit installation.

4.3.3.9 RMY 43408F-12 Blower Motor Assembly

Tools and materials: 5/16 in nut driver

REMOVAL

1. Disconnect the blower power (and optional flow switch) leads from the terminals.
2. Remove the 2 plastic hex nuts that secure the blower clamp.

3. Remove the blower motor assembly.

INSTALLATION

1. Install the replacement assembly by using the 2 plastic hex nuts to secure the blower clamp.
2. Reconnect the power leads ensuring correct polarity.

4.3.3.10 HMP45D Filter

Tools and materials: Flat-head screwdriver.

REMOVAL

1. Loosen the hose clamp.
2. Remove the sensor cover.

CAUTION

Do not touch the sensor elements - they are easily damaged.

3. Remove the sensor from the Aspirated Shield Assembly.
4. The filter is on the top end of the sensor - unscrew and remove the filter. If necessary, rinse the sensor elements with fresh distilled water. The RH Sensor will require time to dry before it reads accurately.

INSTALLATION

1. Screw on the replacement filter.
2. Re-install the sensor into the Aspirated Shield Assembly.

4.3.3.11 Aspirated Shield Assembly

REMOVAL

To remove the complete assembly, reverse the installation procedures in section 3.3.3.5.

INSTALLATION

To install a replacement unit, follow the section 3.3.3.5 instructions for initial Temperature/ Humidity Unit installation.

4.3.3.12 HMP45D Shunt Resistor

Tools and materials: Small 9/16 in flat-head screwdriver, green 7/32 in heat shrink tubing

REMOVAL

1. Remove the battery and verify that the system is powered OFF.
2. Remove the damaged resistor from the terminal block using a small flat-head screwdriver. Save the removed screws.

INSTALLATION

1. Verify that the new (replacement) resistor has the same value as the damaged resistor.
2. Place heat shrink tubing over the ends of the resistor leaving just enough wire to insert the new resistor in the terminal block.
3. Insert the resistor into the terminal block being sure to include any system wiring that shares the pin.
4. Insert the saved screws; gently, but firmly, snug the screws.
5. Reconnect the battery and power the system ON.

4.3.3.13 HMP45D Sensor

Tools and materials: Flat-head screwdriver

REMOVAL

1. Loosen the band clamp.
2. Remove the probe top cover from the top of the probe/cable.
3. Loosen the threaded split bushing securing the probe in place.
4. Remove the probe from the shield mounting tee and disconnect the cable.

INSTALLATION

To install a replacement sensor follow steps 5 through 8, section 3.3.3.5.

4.3.3.14 425AHW Wind Sensor

Tools and material required: 3/16 in Allen wrench and small side diagonal cutter.

REMOVAL

CAUTION

Removal of the Wind Sensor exposes electrical wires on the tower to corrosion. Before removing the Wind Sensor, have a replacement to install.

1. Unscrew the bird spikes (see section 4.3.3.15) and retain them for use on the replacement sensor.
2. Using a 3/16 in Allen wrench, remove the Allen-keyed screw attaching the sensor to the mounting cup. Retain the screw.
3. Using diagonal cutters, snip the tie-wrap holding the cable to the wind sensor mounting cup.
4. Lift the sensor from the mounting cup and disconnect the black plastic connector on the base of the sensor.
5. Replace the Allen-keyed screw (removed in step 2) in the sensor; retain the faulty sensor for return to the NRC.

INSTALLATION

1. Connect the black plastic connector on the base of the sensor.
2. Remove the Allen-keyed screw from the bottom of the wind sensor.
3. Push the cable and connector down into the mounting cup until the sensor seats in the mounting cup.
4. Align the hole in the mounting cup with the threaded hole in the wind sensor and replace the Allen-keyed screw. Finger tighten the screw and turn an additional 1/4 turn using a 3/16 in Allen wrench.
5. Reattach the wind sensor cable to the mounting cup with a fresh tie-wrap. Alignment/realignment of the wind sensor should not be required if the mounting cup remains stable while the wind sensor is replaced. If alignment is required, follow the procedure in section 3.3.3.2.

4.3.3.15 425AHW Bird Spikes

Bird spikes screw into the transducers and are designed to break off with enough material left to unscrew their threaded bases with a pair of pliers. Remove the bird spikes by unscrewing them. Screw in the replacement spikes and finger tighten.

4.3.3.16 425AHW Adapter/Mounting Cup

Tools and materials: Small side diagonal cutters, 5/16 in nut driver, flat-head screwdriver

REMOVAL

1. Remove the wind sensor following the procedure in section 4.3.3.14.
2. Snip the tie-wrap holding the wind sensor cable to the mounting cup.
3. Loosen the hose clamp on the shaft of the mounting cup using a 5/16 in nut driver or flat-head screwdriver. Remove the hose clamp.

4. Remove the mounting cup by gently pulling the disconnected wind sensor cable from the lower shaft of the cup.

INSTALLATION

To install a new mounting cup, follow the installation and alignment procedures in section 3.3.3.2.

4.3.3.17 425AHW Mounting Arm

REMOVAL

1. Remove the wind sensor, bird spikes, mounting cup, and wind sensor cable following the procedures in sections 4.3.3.14, 4.3.3.15, and 4.3.3.16.
2. Reverse the mounting arm installation procedure in section 3.3.3.2.

INSTALLATION

1. Follow the mounting arm installation procedure in section 3.3.3.2.
2. Reconnect/reinstall the wind sensor, bird spikes, mounting cup, and wind sensor cable following the installation and alignment procedure in section 3.3.3.2.

4.3.3.18 425AHW Shunt Resistor

Tools and materials: Small 9/16 in flat-head screwdriver, green 7/32 in heat shrink tubing

REMOVAL

1. Disconnect the battery and verify that the system is powered OFF.
2. Remove the damaged resistor from the terminal block using a small flat-head screwdriver. Save the removed screws.

INSTALLATION

1. Verify that the new (replacement) resistor has the same value as the damaged resistor.
2. Place heat shrink tubing over the ends of the resistor leaving just enough wire to insert the new resistor in the terminal block.
3. Insert the resistor into the terminal block being sure to include any system wiring that shares the pin.
4. Insert the saved screws; gently, but firmly, snug the screws.
5. Reconnect the battery and power the system ON.

4.3.3.19 Base Station

REMOVAL

CAUTION

Be sure to disconnect power to the BS and the RPU while removing and installing the BS. Failure to do so may cause permanent damage.

1. Turn the power switch to the OFF position.
2. Unplug the power cable from the power source and disconnect the cable from the male connector on the side of the BS.
3. If the RS-232 terminal connector cable is connected, disconnect it from both the connected PC and the female connector on the side of the BS.
4. Unscrew the omni antenna (left hand threads).

INSTALLATION

1. After ensuring that power to the RPU is OFF and that the BS's power switch is in the OFF position, screw on the omni antenna (left hand threads).
2. Position/mount the BS.
3. Connect the power cable between the AC power source and the male connector on the side of the BS.
4. Connect the RS-232 terminal connector cable between the selected port PC and the female connector on the side of the BS.
5. Perform the BS setup routines in section 3.4.

4.3.3.20 Directional Antenna

REMOVAL

To remove the complete assembly, reverse the installation procedures in section 3.3.3.4.

INSTALLATION

To install a replacement antenna, follow the instructions in Section 3.3.3.4.

4.4 Performance Verification

The following procedure will verify system performance after replacement of failed or faulty FRUs.

1. Plug the technician's laptop computer into the AC receptacle on top of the power distribution module.

2. Open the terminal and set the com port of the laptop computer to the available port (Comm1, 2, 3, 4..). Set the baud rate to 9600, data bit 8, parity none, 1 stop bit, flow control none.
3. Connect the SDL com3 to the selected com port on the laptop computer with the DB9 to DB9 Technician's cable supplied with the RPU (ASN S200-1A1W1).
4. Type "U," then <ENTER>. The system should display the User menu.
5. Type "Q," then <ENTER>. The system should exit the user interface.
6. Turn on a BS; the BS antenna must be in line-of-sight with the tower-mounted Directional Antenna.
7. Connect the BS to the laptop computer's com port using the BS's terminal cable (ASN S200-1A4W2). Terminal settings need not be changed.
8. Set the BS ID and address to receive data from the RPU. See Appendix D, *BASE STATION SETUP*.

After a few seconds, the display should show the ID number and the values for the sensors.

NOTE: It takes up to 2 minutes for winds and up to 5 minutes for AT/RH/DP to update the display with good data values. Until then, the display will show "999" for the non-updated data values.

4.5 Disposition of Failed Items

Return recoverable (SMR Code PAODD) FRU to the NRC. Non-recoverable (SMR Codes PAOOO, PAOZZ) FRUs, cables, and common hardware should be disposed of locally in compliance with NWS and local environmental safety procedures.

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5. PARTS AND PUBLICATIONS

5.1 Field Replaceable Units

FRUs authorized for removal and replacement at RSOIS operating sites are designated by an alphabetic “O” in the third position of the SMR code in the Appendix N *PARTS LIST*.

5.2 Depot Replaceable Units

Depot replaceable units (DRU) authorized for removal and replacement only at the NWS depot are designated by a “D” in the third position of the SMR code in the Appendix N *PARTS LIST*.

5.3 Publications

Publications listed in this section are available to replace lost, damaged, or missing site manuals.

Table 5: Publications

ASN	Publication	Publisher	CAGE	Part Number
S200-1A1SOM	Standard Zeno®-3200 Operating Manual	CES	39825	S1023Z
S200-1A1ZOM	RSOIS Supplements to Zeno®-3200 Operating Manual	CES	39825	S1501
XRSOIS-TM	RSOIS Organizational Level Maintenance Manual	NWS		

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6. DRAWINGS

TOP DOWN BREAKDOWN

Remote Processing Unit

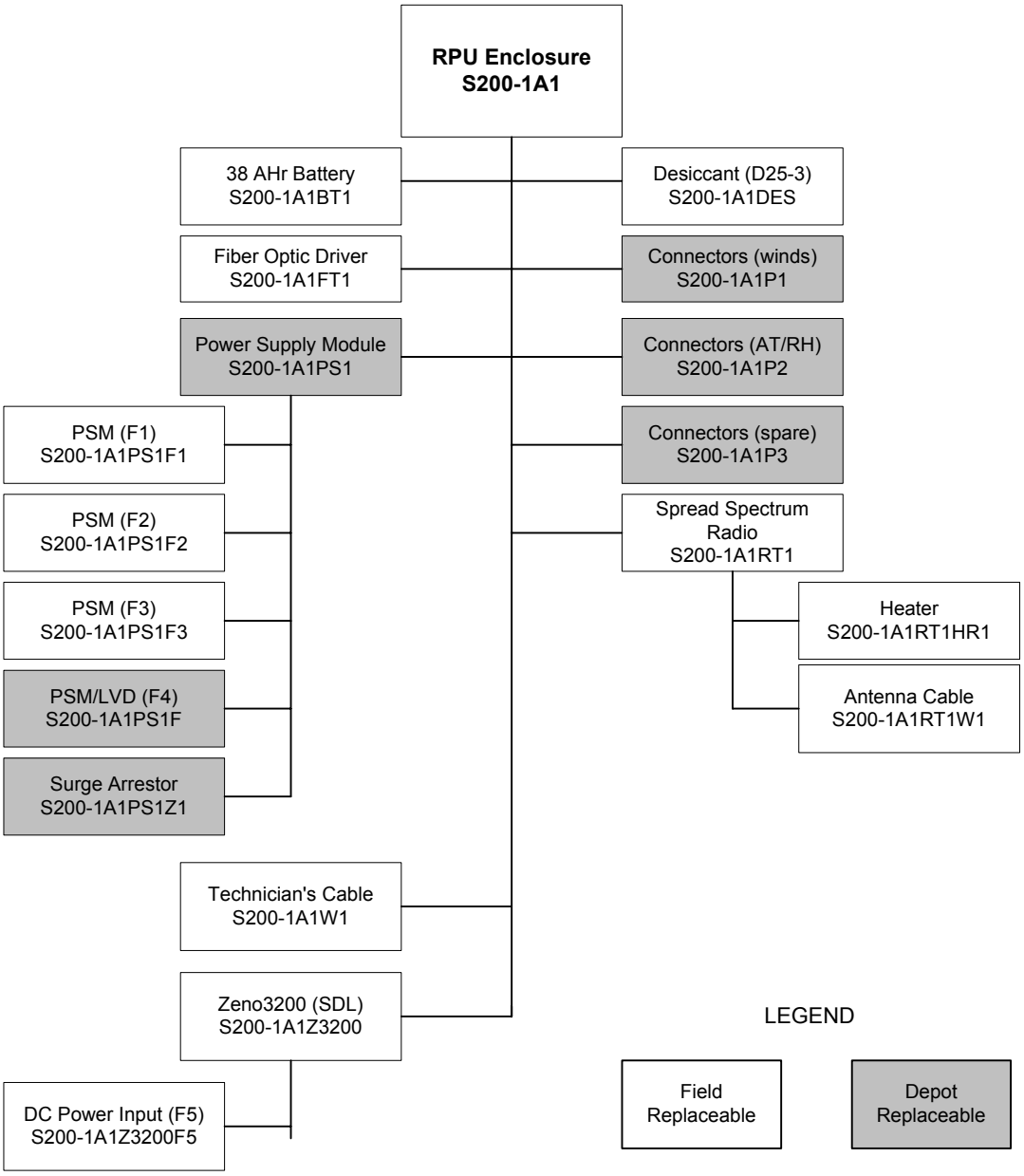

Figure 14: Remote Processing Unit

Temperature/Humidity Unit

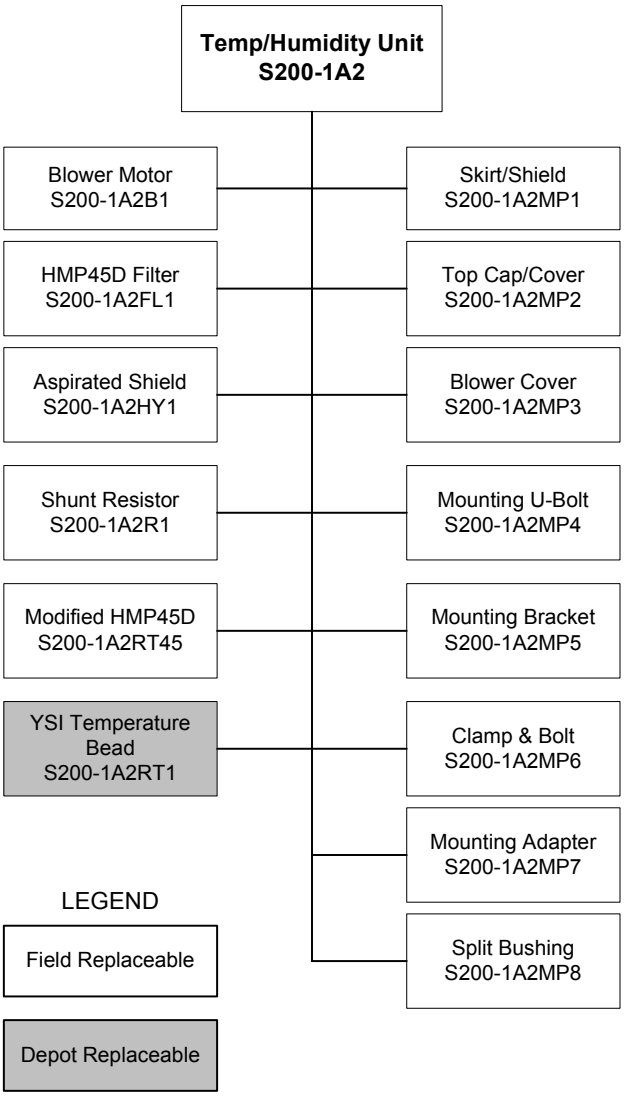

Figure 15: Temperature/Humidity Unit

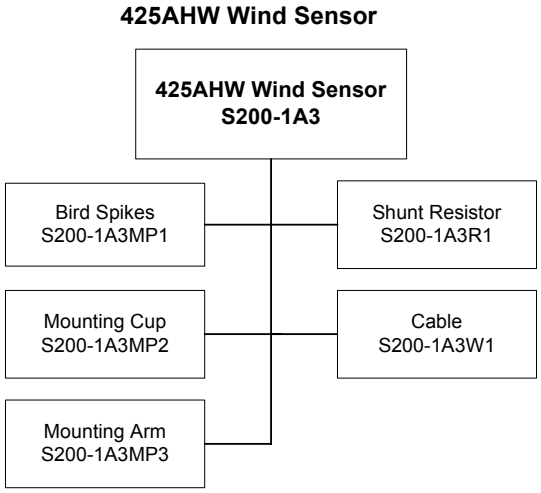

Figure 16: 425AHW Wind Sensor

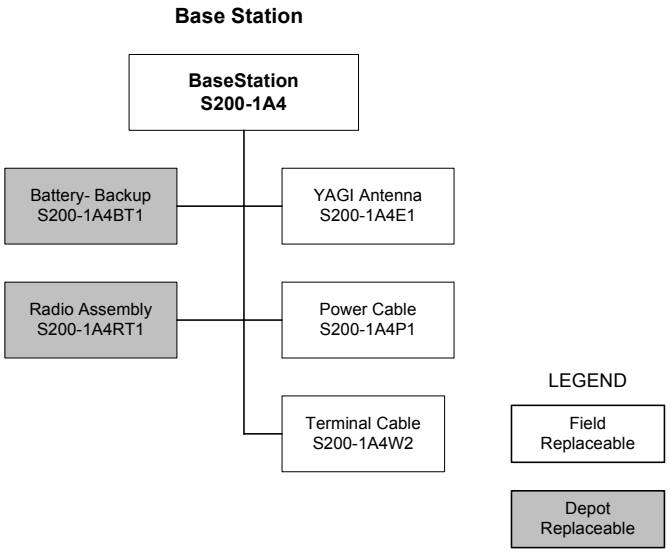

Figure 17: Base Station

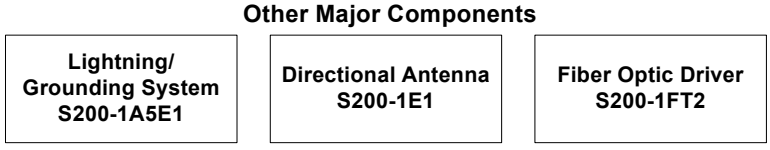

Figure 18: Other Major Components

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7. MAINTENANCE REPORTING

Initiate a maintenance report for all routine or non-routine maintenance activity associated with RSOIS equipment activation, deactivation, modification, or when special sampling is conducted. Use the Engineering Management Reporting System (EMRS) Data Entry System to submit maintenance request and to report maintenance activity. If there is no access to the data entry system, employees will follow locally established procedures to ensure proper notification of the maintenance request and documentation of maintenance activity. Detailed instructions on accessing and using EMRS is found in NWS 30-2104.

? Signature Not Verified

Mark S. Paese

Digitally signed by Mark S. Paese
DN: cn=Mark S. Paese, o=DOC/NOAA/NWS, c=US
Date: 2003.03.18 14:37:37 -05'00'

Mark S. Paese
Director, Maintenance, Logistics, and Acquisition Division

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APPENDIX A

RADIOSONDE SURFACE OBSERVING INSTRUMENTATION SYSTEM (RSOIS) DESCRIPTION

The RSOIS is an automated surface observing system used by the National Weather Service (NWS) to report sensor data as required for radiosonde (rawinsonde) development and radiosonde observation. The system has six major components: Remote Processing Unit (RPU), Temperature/Humidity Unit, Wind Sensor, Base Station, Lightning/Ground System, and Directional Antenna.

The RPU is housed in a stainless steel NEMA-4 enclosure. It consists of a system data logger (SDL), power supply, 12 volt battery, communications (spread spectrum radio and fiber optic driver) and sensor inputs. Data are measured, received, compiled, and stored from various sensors.

The Temperature/Humidity Unit consists of a combined ambient temperature (AT) and relative humidity (RH) sensor housed in an R.M. Young 43408F-12 Motor Aspirated Shield Assembly. The AT sensor is a YSI 44034 thermistor bead and the RH sensor is a high capacity thin film polymer type HMP45D. The temperature output resistance and RH output voltage are sampled once per second on a 15 bit analog to digital (A/D) channel. A glass encapsulated magnetic reed switch activated by an air flow detector is located at the intake providing fan fail protection. The time constant to effect a 5°C change in ambient temperature (AT) and calculated dew point (DP) is five minutes while aspirated.

Wind speed and direction are measured by a Vaisala/Handar 425AHW Ultrasonic Wind Sensor. It is setup in SDI-12 sub mode B. The sensor has thermostatically controlled heaters in the transducer head to prevent freezing rain or snow buildup. Every 5 seconds the sensor is polled and returns a 5 second vector average wind speed, vector average wind direction, heater circuit quality and other data.

The Base Station is a battery-backed, alternating current (AC) powered receiver and transmitter with a liquid crystal display (LCD). The Base Station communicates with the RPU via the included spread spectrum radio. The Base Station is made up of an antenna (left hand threads), power cable and RS-232 cable. Several hours prior to use, the Base Station should be plugged into a standard 115 VAC outlet. The Base Station is mobile and can operate several hours without AC power. The power switch activates the unit as the power light on the Base Station illuminates and remains "ON." If the Base Station is receiving data, the data light illuminates approximately every 5 to 6 seconds. The Base Station must be programed for use with the RPU using primary and secondary IDs (see Appendix E).

The system employs four levels of lightning protection and diversion. The first level consists of the tower, connected as directly as possible, to an earth grounding system. The second level diverts the induced currents via the metallic electronics enclosure to earth ground. The third level uses a resistor-capacitor decoupling network, acting in concert with the fourth level, a resistor-diode network. These networks are built into each line entering a sensitive semi-conductor device; they reduce any residual energies below the micro joule thresholds required

to avoid component degradation or failure. The tower-mounted RPU and sensors are well grounded with lightning rods.

The directional antenna is a mast-mounted, vertically polarized MAXRAD MYP-24008 enclosed Yagi antenna for the 2400 to 2483.5 MHz frequency band.

A-1 REMOTE PROCESSING UNIT

The RPU is in a stainless steel NEMA-4 enclosure housing the SDL, power supply, 12 volt battery, communications (radio assembly and fiber optic driver), and sensor inputs. Data are measured, received, compiled, and stored from different sensors. The connectors for the wind and air temperature sensors, and a spare for a future air pressure sensor are located on the enclosure underside. Caps for each MIL-SPEC connector are chained to the connector assembly and can be easily screwed over the connector, if a sensor is not connected or is temporarily removed. There is a connector for laptop communications with the SDL and a non-metallic 1 in liquid tight flexible connector for the power and fiber optic cable. All attachment hardware is stainless steel; aluminum mounting brackets are anodized or iridited.

The RPU is transient and lightning-protected via a lightning protection kit, as well as a circuit board level capacitor and diodes. The RSOIS battery backup allows the unit to operate several hours without AC power depending on the temperature. To completely power the system down, the battery must be disconnected.

The door of the enclosure is grounded by a grounding strap and the system uses a single point ground. The enclosure has an attachment for a safety ground, as the SDL contains a grounding point for sensor cable shields and is also tied into the system ground.

A maintenance port located inside the enclosure allows direct communication with the SDL via laptop, if the SDL is plugged directly into Com3. This is a standard RS-232 interface with full duplex communication. The baud rate is selectable between 300 and 19,200 bps; the default setting is 9,600 bps. This port is selectable for baud rate, number of stop and start bits, data bits, parity, and handshaking.

A-1.1 Battery

Backup power is provided by a 12 VDC, a 38 amp-hour battery that independently powers the RSOIS for approximately 30 hours operation depending on temperature.

A-1.2 Fiber Optic Driver

The fiber optic driver is an IFS D1010-C transceiver capable of transmitting and receiving RS-232 data signals over standard ST-type 62.5/125 duplex-multimode fiber optic cable.

A-1.3 Power Supply

The RPU operates from a 120 VAC (± 10%), 60 Hz (± 5 Hz) single-phase power source. If the RPU loses power, or resets due to a power surge, it automatically returns to normal operation without human intervention. Normal operation is resumed within 30 seconds, with all weather parameters achieving normal indications within 3 minutes 45 seconds.

A-1.4 Spread Spectrum Radio

Radio linkage is accomplished via the Zeus spread spectrum radio transmitter with Coastal Environmental's standard 1200 baud FSK on-board modem and a Yagi antenna at the RPU end. This antenna has a 60° horizontal beam width and can be aligned visually. The radio and antenna system provides up to a three-mile line-of-sight communication. Other characteristics are shown in table A-1.

Table 6: Spread Spectrum Radio Characteristics

Temperature	-70°C to +60°C with heater option -20°C to +60°C without heater option
Frequency	2.400 to 2.4835 license-free ISM band
Power	10 mW to 500 mW nominal, self adjusting
Protocol	CSMA
Flow control	Support hardware, software, or none
Error detection and correction	CRC 16 error detection

A-1.5 Technician's Cable

Included in the RPU is a 10 ft RS-232 DB-9 Technician's cable. This cable is a high quality, UV protected, modified null modem cable with a female connector on each end.

A-1.6 System Data Logger

The Zeno®-3200 data acquisition SDL controls the sensors, logs data, and controls communications. It is based on the Motorola 68332 32-bit micro-controller, with 512 kB of flash program memory plus 1 MB SRAM. The SDL collects and processes data. The SDL operates at temperatures of - 55°C to + 65°C and is expandable to accommodate additional sensors or alternate communications. The RSOIS contains the same pressure algorithms as the NWS precision digital barometer. A barometer port is already installed in the RPU enclosure. The SDL stores the meteorologic values for a minimum of 24 hours in the present configuration.

The output string is sent from the SDL, translated to the display, and passed to the RS-232 port. This is the same data leaving the Com 3 port of the SDL. Carriage return line feeds are also sent in this string.

```
#05110011
01/01/25,15:26:35,11,13,331,0,20,0,1.3,-5.5,60,20,0,0,8
#05110011
01/01/25,15:26:40,11,13,332,0,20,0,1.3,-5.5,60,20,0,0,9
```

Zeno ID (P) Zeno ID (S)														
YY/MM/DD	HH.MM.SS	ID	SP	WD	WC	PK	PK*	AT	DP	RH	GU	GU*	BIT	CHKSM
#05110011														
1/25/01	15.26.40	11	13	332	0	20	0	1.3	-5.5	60	20	0	0	9

A-2 TEMPERATURE/HUMIDITY UNIT

The combined AT and RH sensors are housed within an R.M. Young 43408F-12 Motor Aspirated Radiation Shield which reduces radiation errors to less than 0.1ºC. The AT sensor is a YSI 44034 thermistor bead and the RH sensor is a high capacity thin film polymer type HMP45D. The radiation shield has a sealed terminal box for easy servicing.

The temperature output resistance and RH output voltage are sampled once per second on a 15 bit A/D channel. A glass encapsulated magnetic reed switch activated by an air flow detector is located at the intake providing fan fail protection. The time constant to effect a 5°C change in AT and DP is 5 minutes while aspirated. (Accuracy: AT = ± 0.2°C, RH = ± 2% at 0 to 90% RH and ± 3% at 90% to 100% RH. DP = ± 2°C. Operating - 40°C to + 55°C. The time constant to effect a 5 °C change in AT and DP is 5 minutes while aspirated.)

A-3 WIND SENSOR

The Wind Sensor is a Vaisala/Handar 425AHW Ultrasonic which measures wind speed and direction. The sensor is setup in SDI-12 sub mode B. Thermostatically controlled heaters in the transducer heads of the sensor prevent freezing rain or snow buildup. Every 5 seconds the sensor is polled and returns a 5 second vector average wind speed, vector average wind direction, heater circuit quality, and other data. (Accuracy: WS = ± 3% of Reading, WD = ± 2°. Operating characteristics are shown in table A.2.)

Table 7: Handar 425 AHW Operating Characteristics

Temperature	- 50°C to + 50°C
Relative humidity	5% to 100% RH
Wind speed	0 to 156 knots
Starting threshold	Virtually zero
Rain	Up to 3 in/hr with 40 knot wind
Freezing rain	Ice accretion to 0.5 in/hr
Electromagnetic interference	Exposure to airport environment
Distance constant	Virtually zero
Icing conditions	Heated

A-4 BASE STATION

The RSOIS Base Station is an AC powered receiver and transmitter with an LCD. It communicates with the RPU via the spread spectrum radio. The Base Station receives radio messages, displays received data, and passes the data to other displays or PC/laptop computers.

The Base Station consists of a modified Zeno®-3200 SDL, spread spectrum radio,1 x 3 or 2 x 5 in LCD, power supply, and battery. It is supplied with an antenna (left hand threads), power cable, RS-232 cable, and can be mounted either independently or in a standard 19 in equipment rack.

The Base Station must be plugged into a standard 115 VAC outlet several hours prior to use. The Base Station is mobile and can operate several hours without AC power. The power switch activates the unit, as the power light illuminates and remains "ON." If the Base Station is receiving data, the data light illuminates approximately every 5 seconds. It must be programmed for use with the RPU using primary and secondary IDs.

The following shows the display:

ID: 11

SP:	9	**WD:**	360	**AT:**	24.4
GU:	0	**WC:**	0	**DP:**	-2.5
PK:	12			**RH:**	16.0

Key

ID: System Identification Number (or Secondary ID)
SP: Current 2 minute average wind speed (WS)(± 3%)
GU: Gust Speed - Maximum WS in the last 600 seconds (10 minutes)

SET IF the SP $9 **AND IF** the difference in the recorded maximum and minimum WS in the last ten minutes is $10 **AND IF** the difference in the recorded maximum WS in the last ten minutes and SP $5

Once set, the GU continues to be reported for at least a 10 minute duration **UNLESS** the difference in the recorded maximum WS in the last 10 minutes and SP $3.

GU: <*Value*> *

An Asterisk (*) is placed to the right of the gust speed value **IF** the SP $20 **AND IF** the current SP $ the SP two minutes ago +15 knots a possible **Squall** condition is indicated. (*Alert Condition*).

PK: The maximum 5 second WS from the sensor in the last 2 minutes (*within the period represented by **SP***).

PK: <*Value*> *

An asterisk (*) is placed to the right of the peak WS value **IF** the PK $20 an NWS **reportable** Peak WS is indicated. (*Alert Condition*)

WD: Current 2 minute average wind direction([WD) in degrees (± 2 degrees)

WC: 0 = Steady WD, 1 = Variable WD

SET IF the current SP is greater than 6 knots, **AND** the total WD range in the current 2 minute average is 60°or more.

AT: Current 5 minute average temperature in degrees Celsius.(± 0.5°C)

DP: Current 5 minute average dew point temperature in degrees Celsius.(± 2.0°C)

RH: Current 5 minute average relative humidity by percent (± 3%)

A-5 SYSTEM INTERFACES

The RSOIS is configured to interface with, be controlled by, and display data on the NWS Radiosonde Replacement System Computer Workstation. An RS-232 maintenance interface on the SDL connects to the maintenance technician's laptop computer. Standard communication interface software is used to communicate with the system, as well as to receive the broadcast data. The communication interface software can be any software capable of receiving ASCII text, and is independent of the operating system. Packages that can be used in a DOS or Windows environment include: Procomm, Hyper Terminal (included with Windows), and Reflections.

A-6 COMMUNICATION OPTIONS

Communication can be transmitted by either the included 2.4 GHz spread spectrum radio/directional RPU antenna or the optional fiber optic driver. An additional fiber optic diver (S200-1FT2) and the appropriate length of ST-type, plenum/outdoor rated, duplex multi mode 62.5/125 micron-core cable with grip mounts and boots must be ordered from the designated supply source before the fiber optic driver can be used.

APPENDIX B

INSTALLATION CHECKLIST

Site Name: _____ Site 9-Digit ZIP Code: _____

Installation check by (full name): _____ Date: _____

NOTE: Parenthetical technical manual references precede each requirement.

1. (3.3.1) Pre-installation approval received.

   Site and sensor orientation . . . . . Initial here_____

2. (3.3.1, 3.3.3) Tower lightning protection installed.

   Inspection/installation action . . . . . Initial here_____

3. (3.3.1, 3.3.2) Tower power available/installed and tower properly grounded.

   Inspection/installation action . . . . . Initial here_____

4. (3.3.1, App C) Solar noon obtained using (_____) method and recorded as (_____).

   Installation action . . . . . Initial here_____

5. (3.3.1) Base Station antenna (left hand threads), power cable, and terminal cable connected; power applied; serial number (_____) and Base Station ID (_____) recorded.

   Installation action . . . . . Initial here_____

6. (3.3.3) Wind Sensor aligned, installed, and serial number (_____) recorded.

   Installation action . . . . . Initial here_____

7. (3.3.3) RPU delivered complete (including a heater if the RPU radio will be used in temperatures below - 30°C) and the following recorded:

   RPU serial number (_____)
   Zeno-3200 SDL serial number (_____)
   RPU primary ID (_____) [from inside of RPU enclosure door]
   RPU secondary ID (_____) [from inside of RPU enclosure door]

   Visual inspection . . . . . Initial here_____

8. (3.3.3) Verify that the caution label is on the RPU power module.

   Visual inspection . . . . . Initial here_____

9. (3.3.3) The SDI-12 resistor is in place and is at COM 2B and RTN on the Zeno® 3200 terminal blocks.

Visual inspection . . . . . Initial here_____

10. (3.3.3) The Temperature resistor is in place between AGND and CH7-.

Visual inspection . . . . . Initial here_____

11. (3.3.3) The braided grounding strap grounding the door to the RPU enclosure is properly attached.

Visual inspection . . . . . Initial here_____

12. (3.3.5) The RPU is mounted, wired, and grounded.

Installation action . . . . . Initial here_____

13. (3.3.3) The Directional Antenna is mounted and oriented within plus or minus 15° of the Base Station antenna.

Installation action . . . . . Initial here_____

14. (3.3.3) The Temperature/Humidity Unit sensor is mounted at within the optimum height range, is correctly wired, and properly grounded.

Installation action . . . . . Initial here_____

15. (3.3.4) All connections checked, the system powered and the following voltages recorded:

Table 8: Power Voltages

Description	Value	Limits
Measured (with digital multi-meter) powered AC input voltage on the Power Supply Module.		110 - 120 VAC
Measured (with digital multi-meter) DC power voltage at the Zeno®3200 System Data Logger		13 - 14 VDC

Installation action . . . . . Initial here_____

16. (3.4.1, App D, App E) Terminal program installed on connecting (to the Base Station) personal or laptop computer.

Installation action . . . . . Initial here_____

17. (3.4.1, App D) Procomm setup complete.

Installation action . . . . . Initial here_____

18. (3.4.2, App E) Base Station setup complete.

Installation action . . . . . Initial here_____

19. (3.4.3) Terminal communications to the Base Station established.

Installation action . . . . . Initial here_____

20. (3.4.3) Terminal communications to the RPU (SDL COM 3 port) established using Procomm.

Installation action . . . . . Initial here_____

21. Verify that the green transmit light on the RPU Fiber Optic Driver pulses every five to six seconds.

Visual inspection . . . . . Initial here_____

22. (3.4.4) Radio communication established between the Base Station and the RPU.

Installation action . . . . . Initial here_____

23. (3.4.5) The Base Station displays prescribed readings and is updated every five to seven seconds. Complete the following table.

Table 9: Base Station Displays

Element	Display Code	Reading at Installation
2-minute wind speed	SP	*Knots*
Wind gust	GU	*Knots*
Wind peak	PK	*Knots*
2-minute wind direction	WD	°
Wind condition	WC	*0=Steady* *1=Variable*
Ambient temperature	AT	°C
Dew point	DP	°C
Relative humidity	RH	%

Installation Action . . . . . Initial here_____

24. (App I) Wind sensor checks performed via the SDL's COM 3 port. Complete the following table.

Table 10: Wind Sensor Checks

Element	425AHW Values	Limits
SDI-12 version ("0I!")		>11
Model #		425AHW
Firmware version		>5.11
Submode B ("0X?!")		1
Units (knots) ("0x*!")		1
Heater Status ("0R0!")		0
Heater power supply voltage		36-40 VDC

Installation Action . . . . . Initial here_____

25. (App I) Wind bit message and retest function checked by the following procedure: While still connected to COM 3 port, the wind sensor connector was removed from the RPU. If it was 0 the Bit message changed to 80008; if the bit message was other than 0, then the 80008 was added to the previous value (hexadecimal number).

Installation Action . . . . . Initial here_____

26. (App J) System time (GMT) was checked (and corrected, if necessary) at the Base Station.

Installation Action . . . . . Initial here_____

27. (App H, App K) RSOIS operating parameters verified. Complete the following table.

Table 11: RSOIS Operating Parameters

Element	Output	Limits
Battery voltage		13.8 VDC ±0.5
RPU/SDL internal temperature		As recorded ± 0.2°C of ambient
Built-in-test code		None. OR check code sheet.
Sample period		Item 1: 5 Item 2: 5 Item 3: 0
Memory storage		915700

Installation Action . . . . . Initial here_____

APPENDIX C

OBTAIN SOLAR NOON

C-1 GENERAL

There are two sources from which to obtain solar noon at the installation (tower) site. The preferred source is the Solar Noon Program available via the ASOS Technician's Page. This source can be used when the exact latitude of the tower is known. The second source, which provides a less precise value, is the U. S. Naval Observatory.

C-2 WHEN THE SITE'S LATITUDE IS KNOWN

Obtain the local solar noon time for the installation (tower) using the Solar Noon Program available via the ASOS Technician's Page at FTP://140.90.16.200/ASOS

Complete the following steps:

1. Open the page and select the folder "solar noon/".
2. Install the folders (and contents) of "disk1/" and "disk2/" on a personal or laptop computer (assign desired destination directory and file names).
3. Run "sunprog" to display the template shown in .:

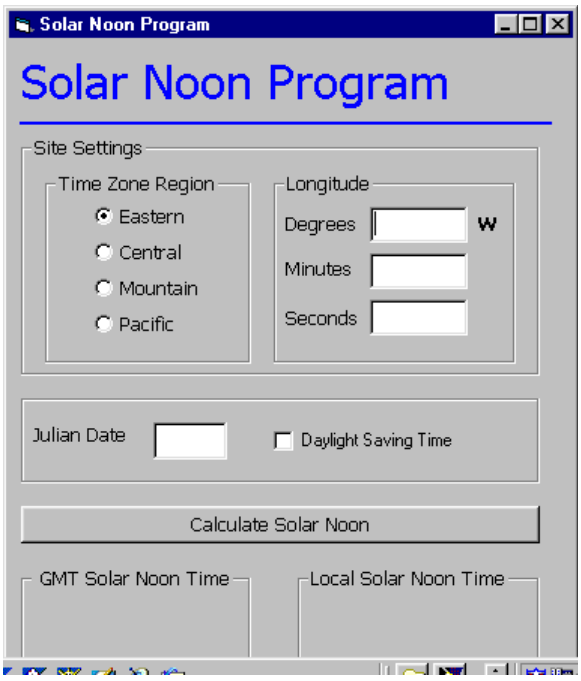

Figure 19: Solar Noon Template

4. Complete the template; press "Calculate Solar Noon".

5. Record the displayed values and enter them on the Installation Checklist.
6. Exit the solar noon program.

C-3 WHEN THE SITE'S LATITUDE IS UNKNOWN

If unsure of the site's exact latitude, a good approximation for the solar noon can be obtained for the site's general location, by city, at:

http://aa.usno.navy.mil/data/docs/RS_OneDay.html

1. When opened, complete the template as shown in figure 20. Use the largest city closest to the site's location if the site's city is not listed.

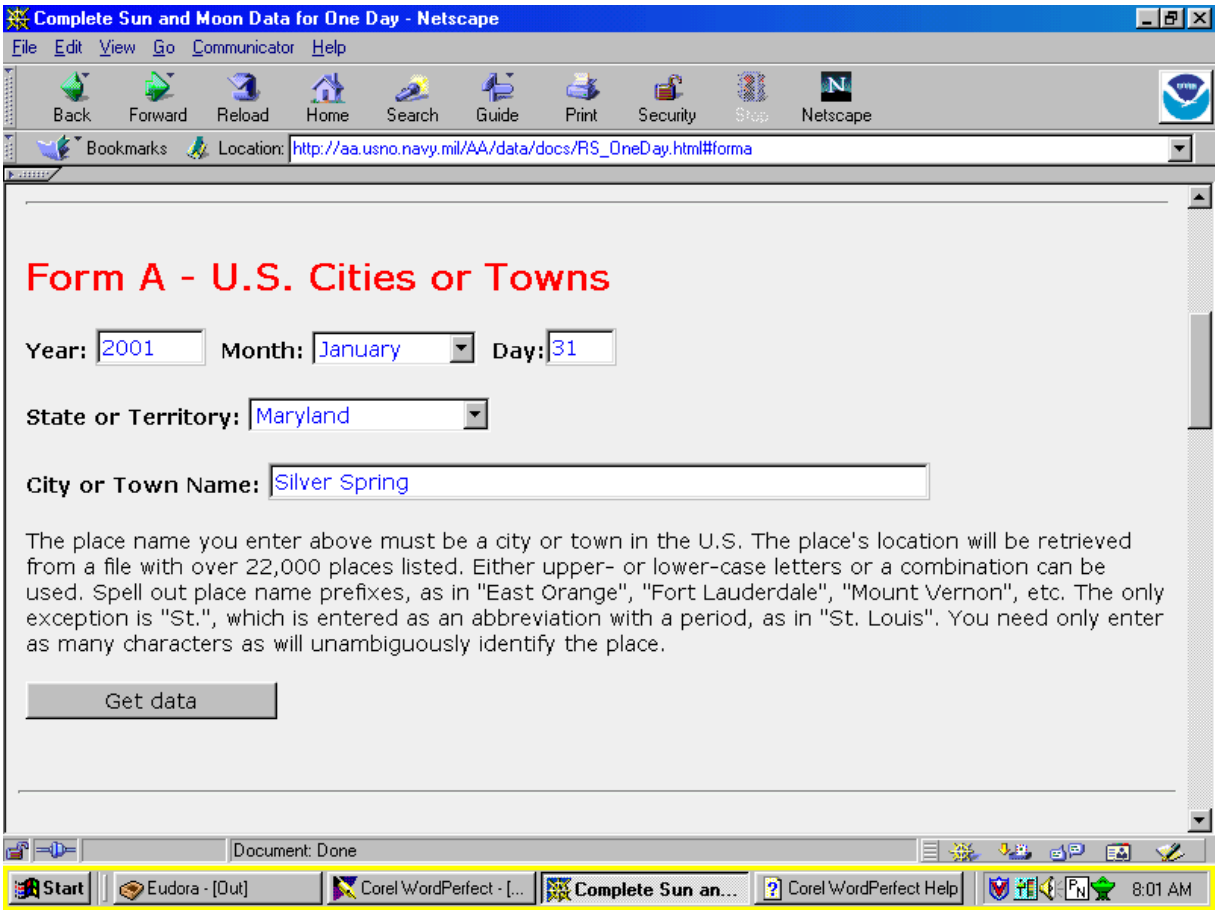

Figure 20: City Locator Form A

2. Press “Get data” to obtain values as illustrated in figure 21.

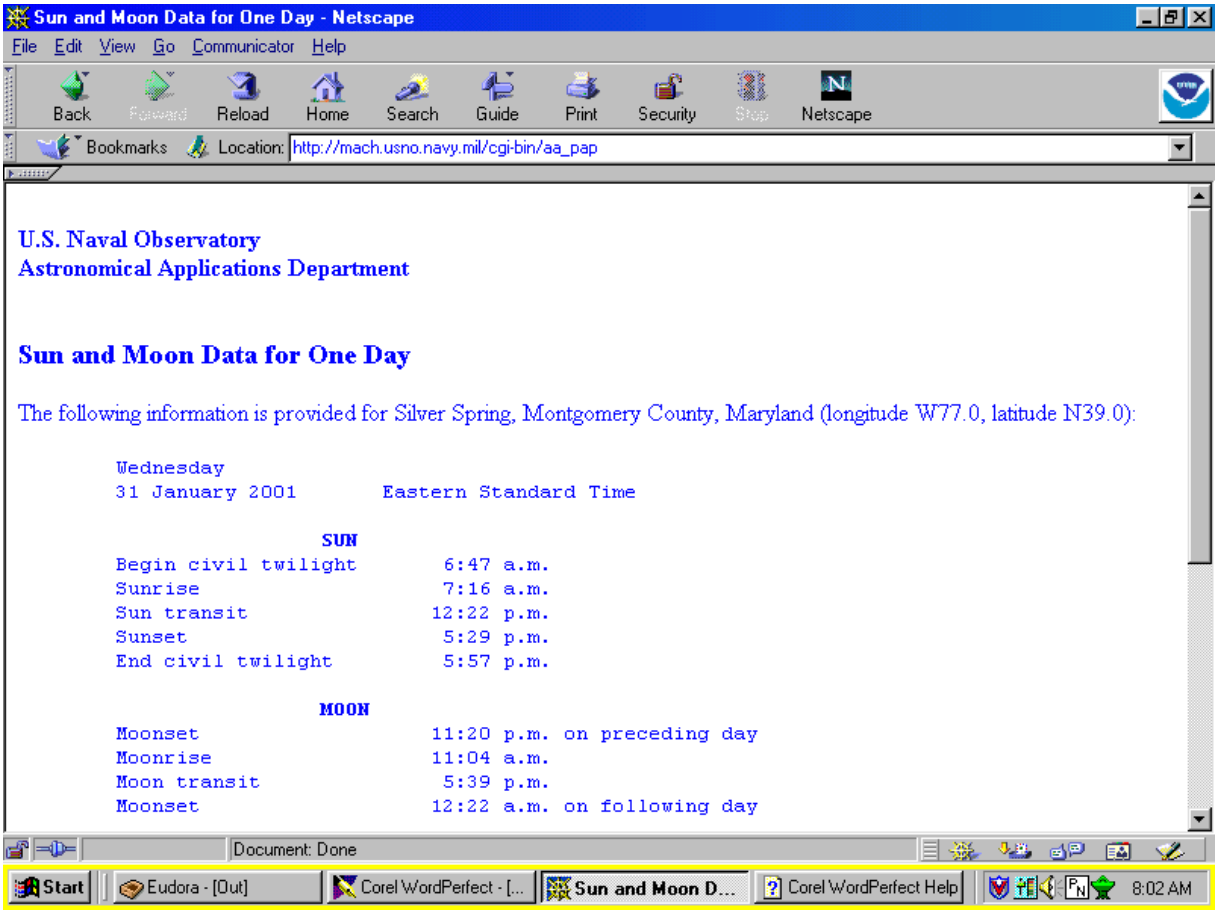

Figure 21: Longitude/Latitude Values

3. Record the displayed values and enter them on the Installation Checklist. This method yields the time for the **Sun Transit**, which is equivalent to solar noon

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APPENDIX D

SETUP PROCOMM

With the RS-232 cable of the Base Station connected to a personal or laptop computer, open Procomm (or another terminal program) and select:

Options * Data Options * Terminal Options

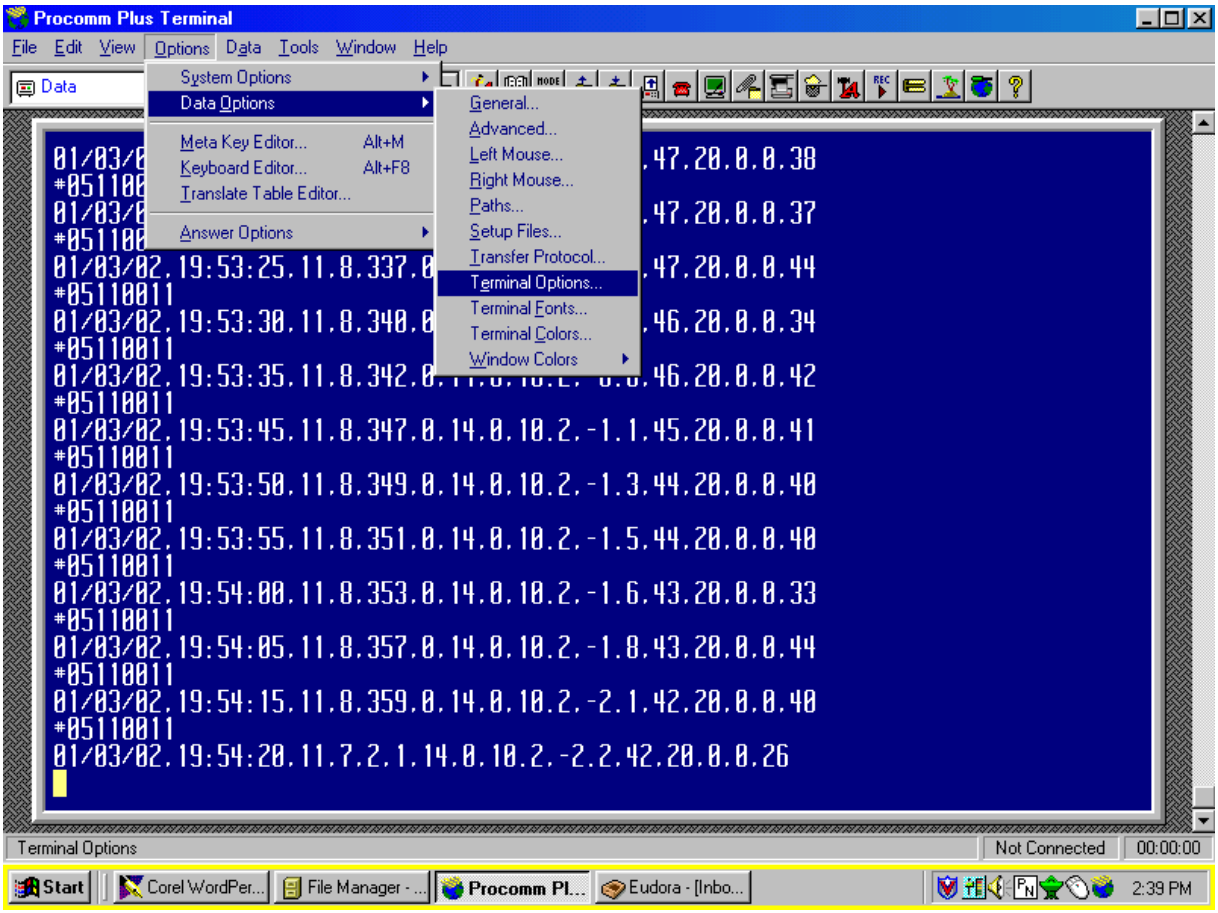

Figure 22: Options * Data Options * Terminal Options

Select **VT100** from the Current Terminal scroll-down menu and other items as indicated in the Setup screen.

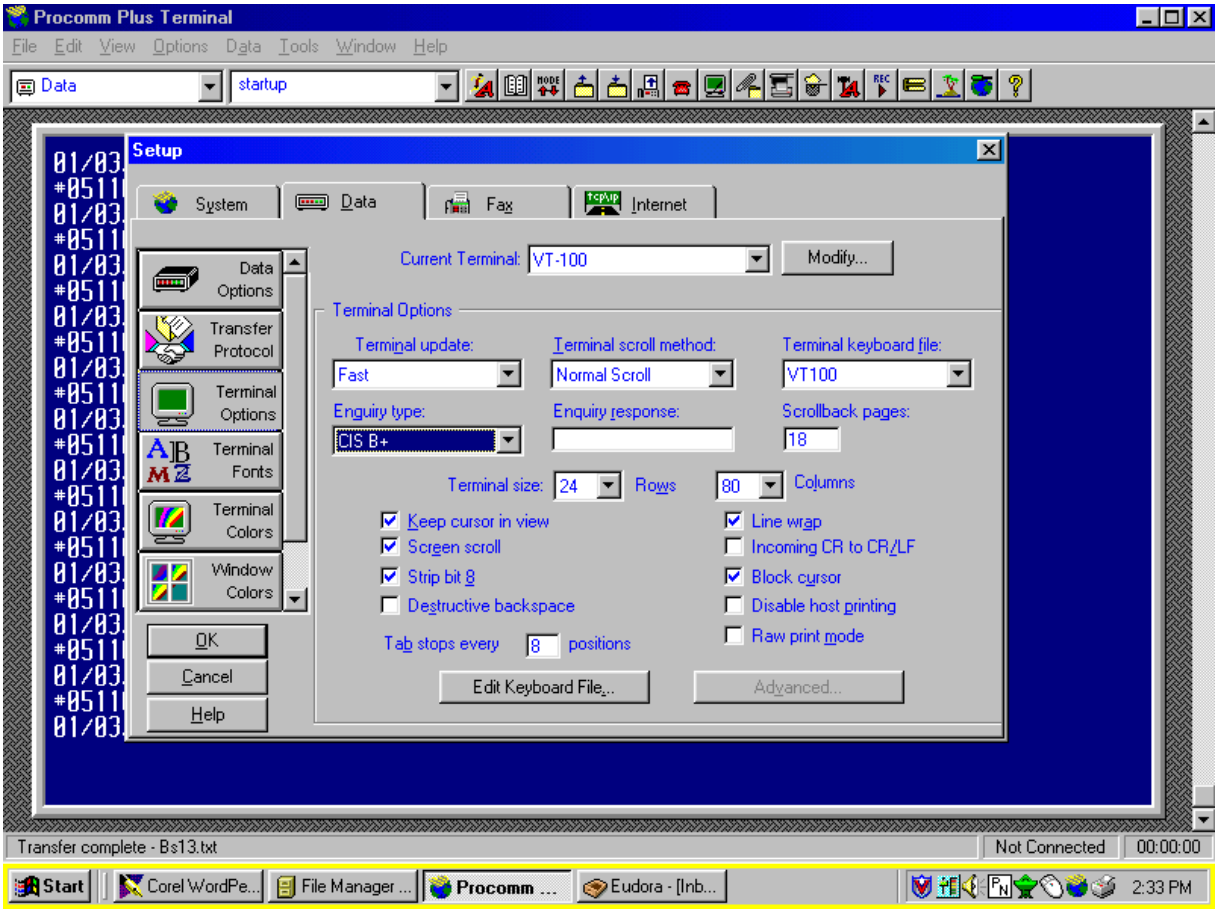

Figure 23: Setup Screen

Select **OK**.

Go to:

Options * Data Options * Transfer Protocol

(ASCII will work in many cases.) Using Procomm with the ZENO®3200 SDL requires the use of XModem protocol to send data from a host computer.

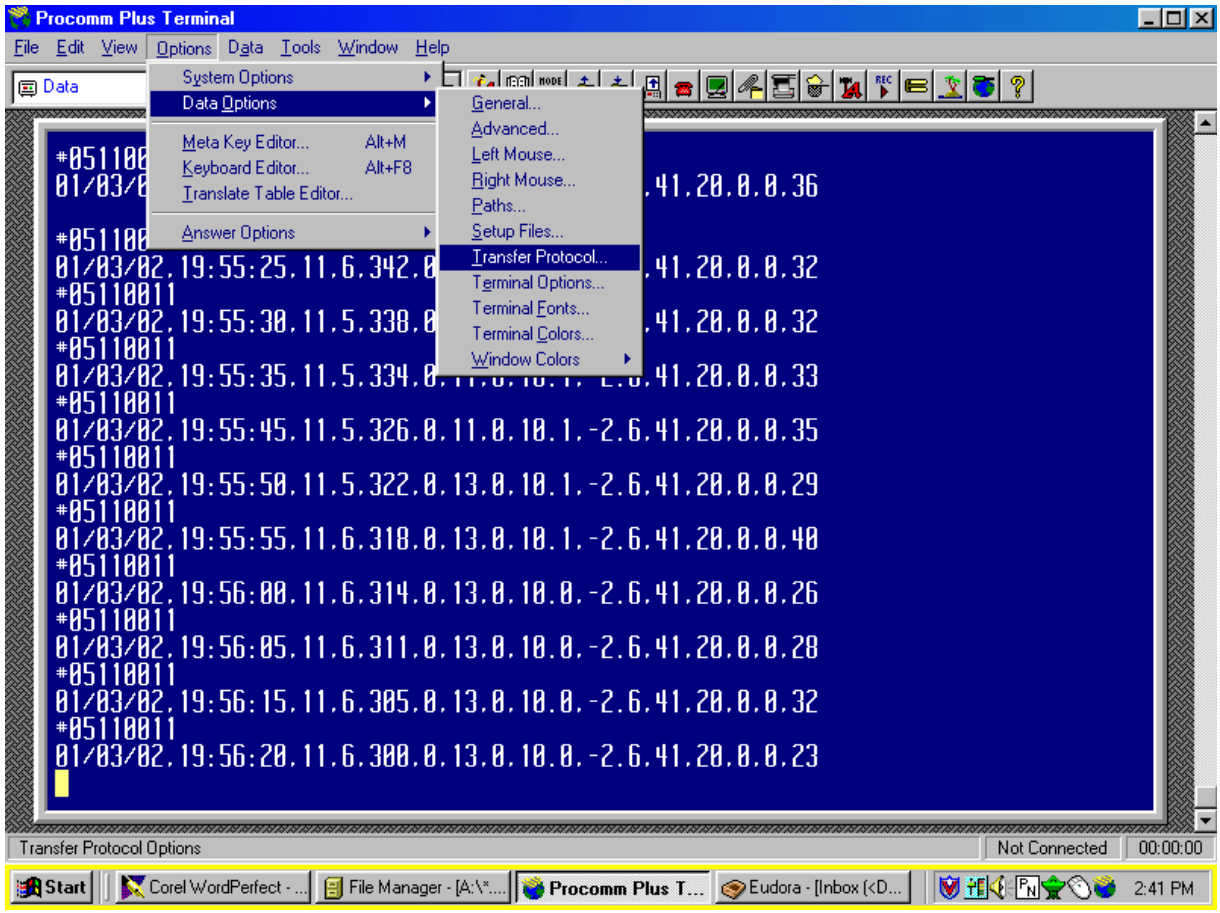

Figure 24: Options * Data Options * Transfer Protocol

The Setup screen for Current Transfer Protocol displays as shown in figure 25.

Select **Xmodem** from the Current Terminal Protocol scroll-down menu.

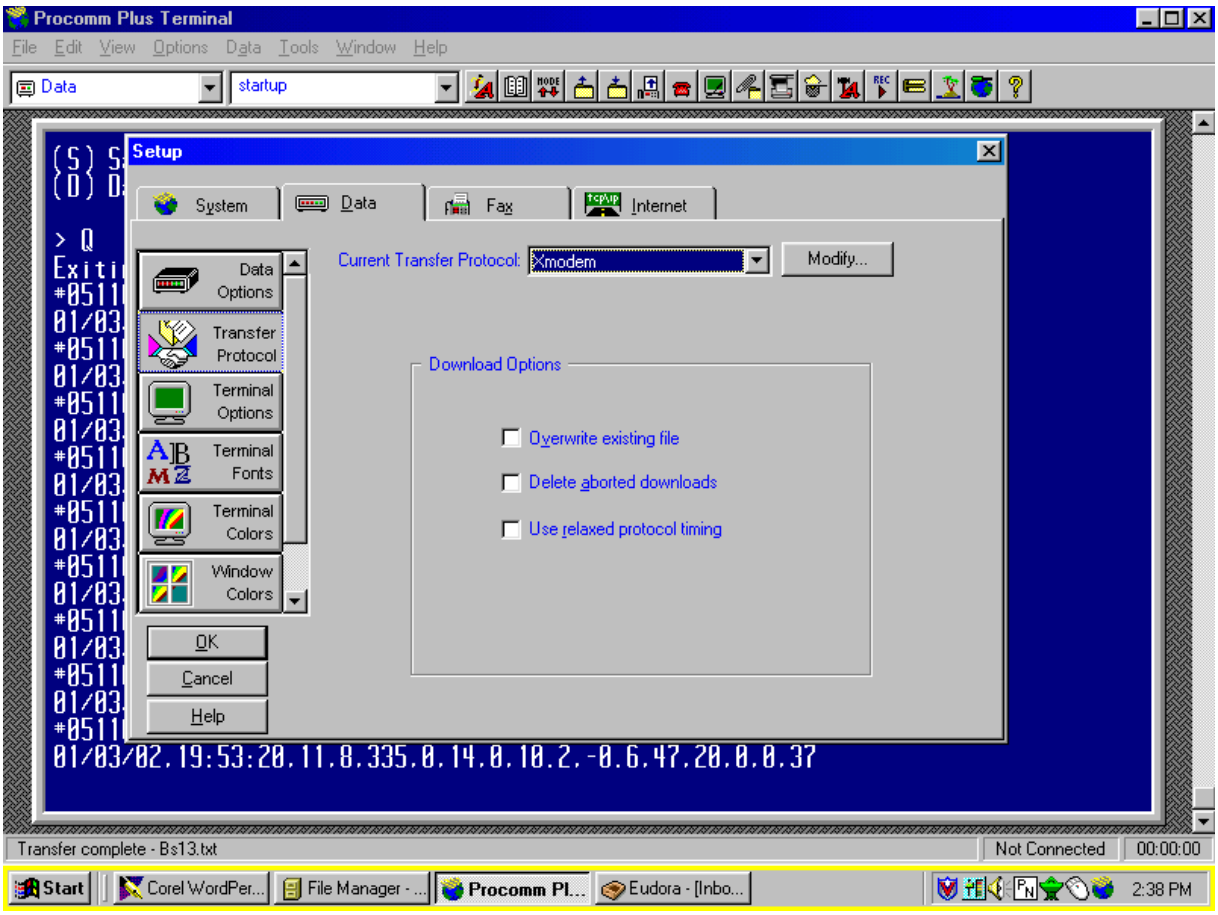

Figure 25: Current Terminal Protocol Scroll-down Menu

Select **OK**.

Select:

Options * System Options * Modem Connection

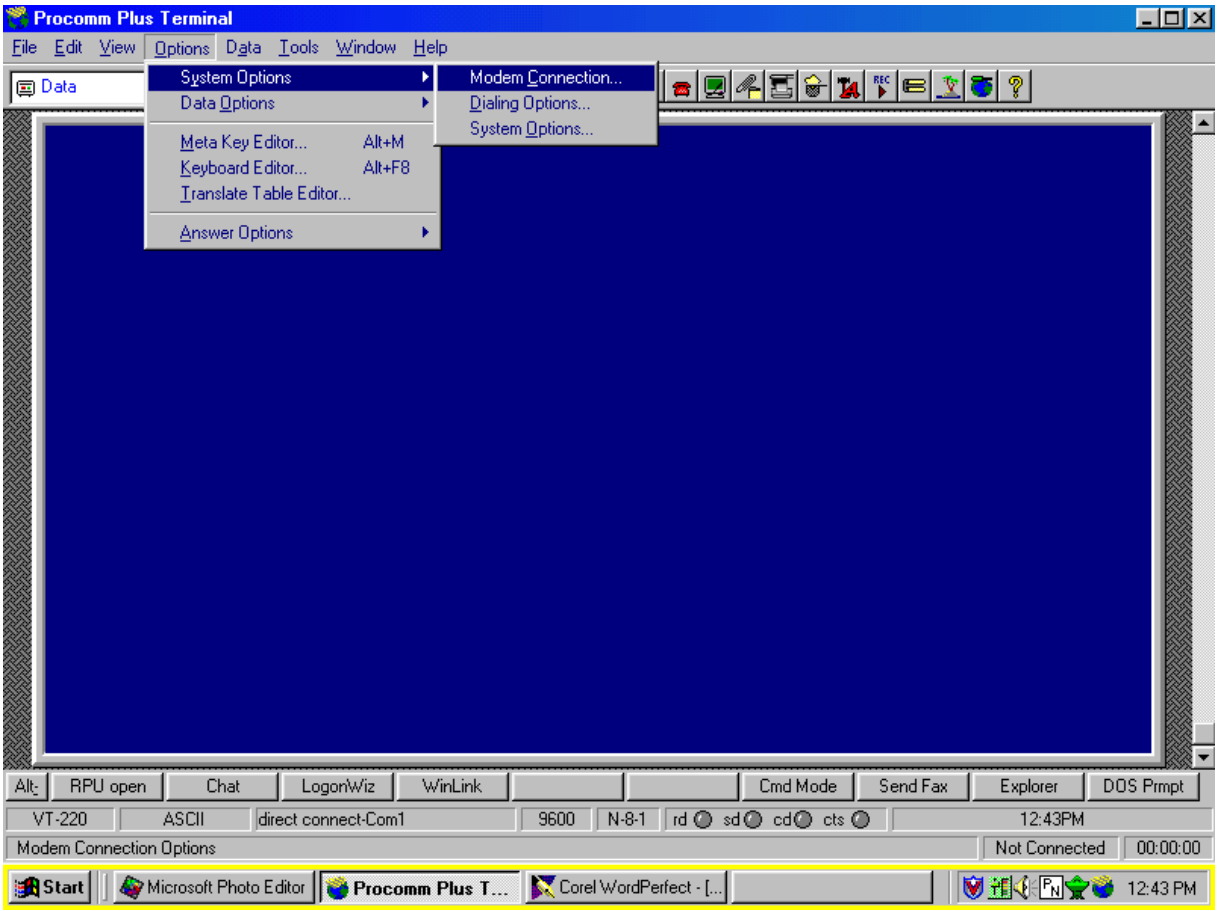

Figure 26: Options * System Options * Modem Connection

Select:

Modem Connection

Set Current Modem/Connection to:

direct connect-Com1

Click **Modem/Connection Properties**. The Modem/Connection Properties window displays as shown in figure 27.

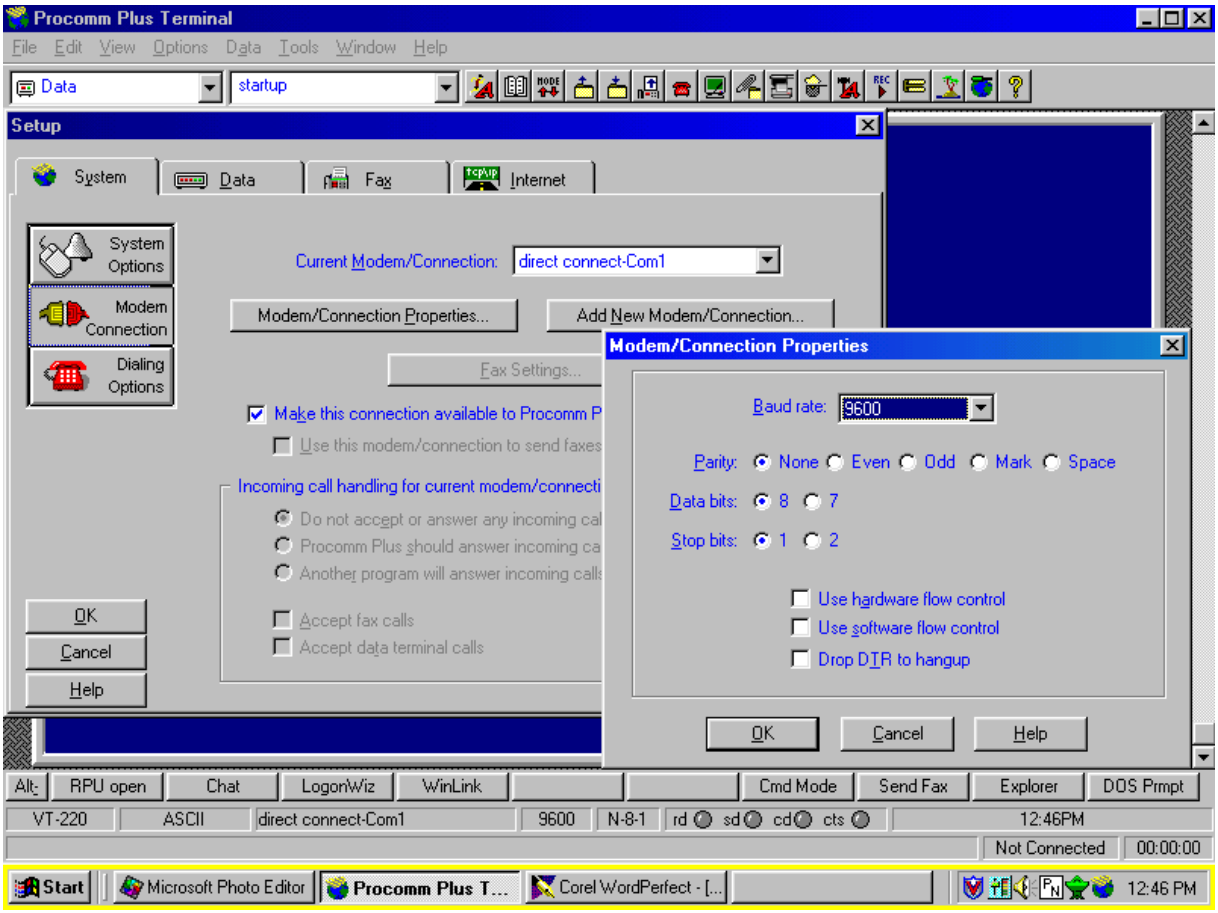

Figure 27: Modem/Connection Properties Window

Setup the system Baud rate for **9600**, Parity - None, Data bits - 8, and Stop bit - 1.

Click **OK** and **OK** again to exit the Modem Connection Setup.

Select:

Options * Meta Key Editor

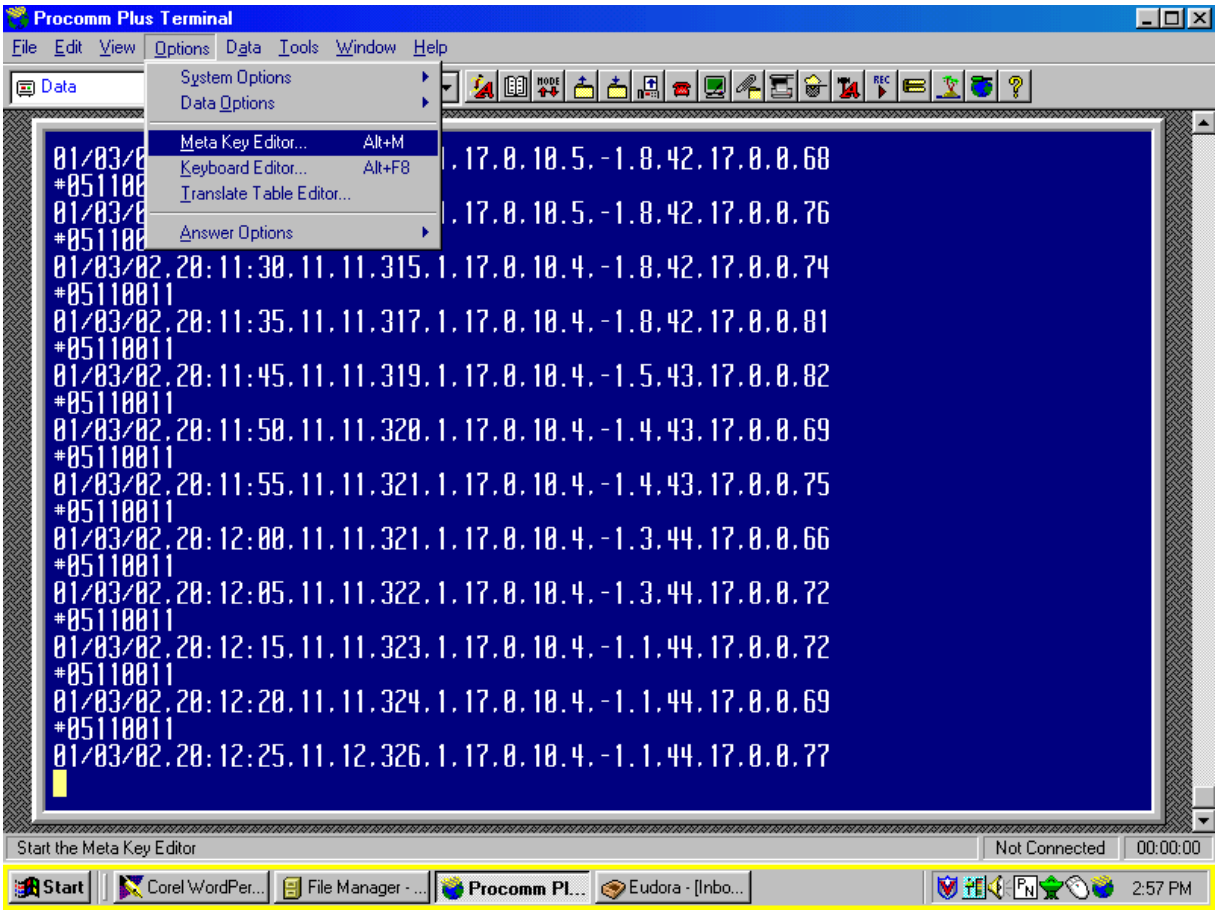

Figure 28: Meta Key Editor

Click:

Media Key Editor

The Procomm Plus Meta Key Editor - RSOIS key window displays as shown in figure 29.

Enter the following values for Key 1:

	Action	Contents	Label
Alt:	**Send Text**	**#99990001PT232109600N8,18^C**	**RPU Open**
Alt Shift:	**Send Text**	**#99990001SETPARAM3,1,14^C**	**RPU TIME1**
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Send Text**	**#99990001PTSDI2,03^C**	**425AHW**

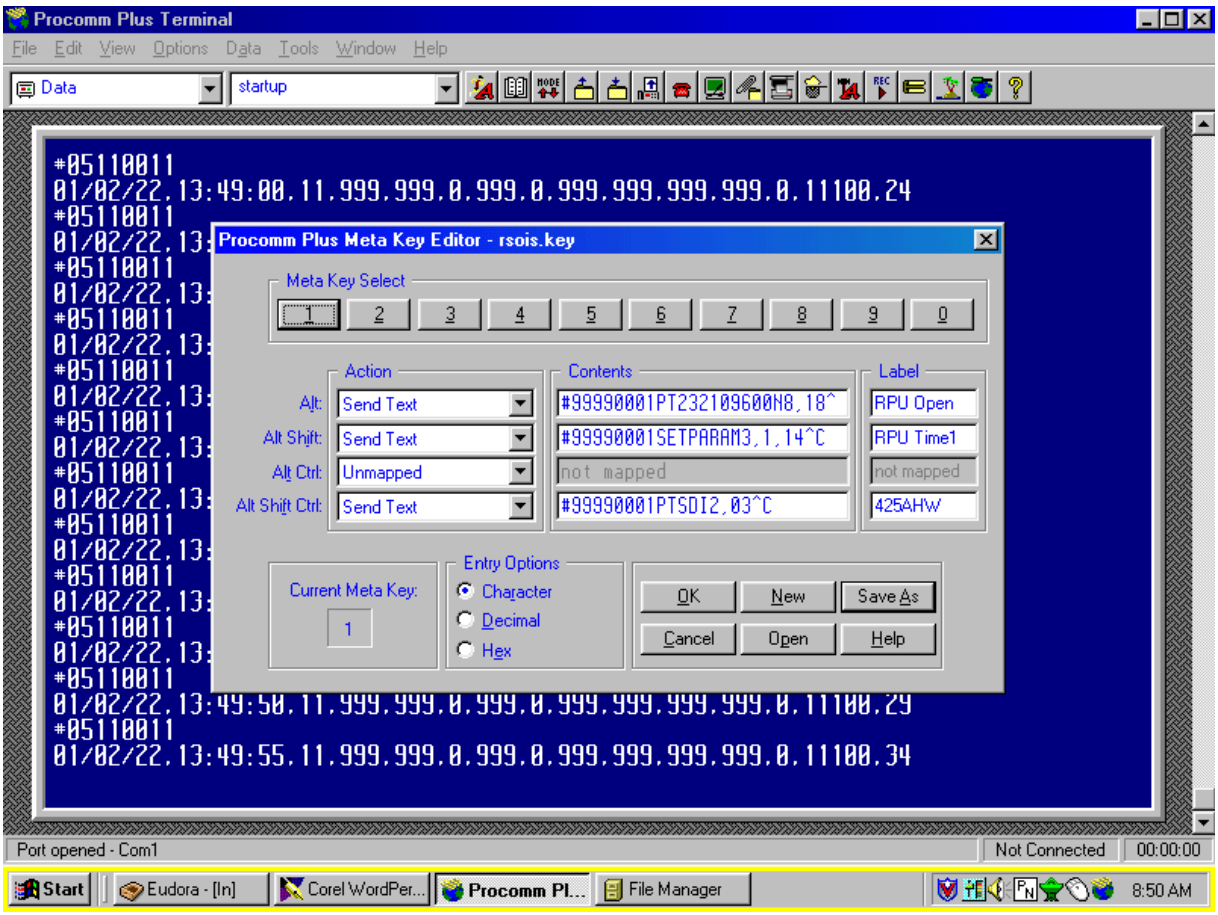

Figure 29: Procomm Plus Meta Key Editor - RSOIS key window

Enter the following values for Key 2:

	Action	Content	Label
Alt:	**Send Text**	**#99990001OPEN,71^C**	**Open Zeno**
Alt Shift:	**Send Text**	**#99990001SETPARAM1,3600,64^CRPU TIME2**	
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 3:

	Action	Content	Label
Alt:	**Send Text**	**U^M T^M B^M Q^M**	**BIT Check**
Alt Shift:	**Send Text**	**U^M F^M S^M**	**RPU TIME3**
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 4:

	Action	Content	Label
Alt:	**Send Text**	**U^M S^M Q^M**	**Period CK**
Alt Shift:	**Unmapped**		
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 5:

	Action	Content	Label
Alt:	**Send Text**	**U^M D^M C^M Q^M**	**Memory CK**
Alt Shift:	**Unmapped**		
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 6:

	Action	Content	Label
Alt:	**Send Text**	**U^M D^M**	**DATA RX**
Alt Shift:	**Unmapped**		
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 7:

	Action	Content	Label
Alt:	**Send Text**	**U^M T^M S7,7^M**	RPU VDC
Alt Shift:	**Unmapped**		
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 8:

	Action	Content	Label
Alt:	**Send Text**	**U^M T^M S1,1M**	**RPU Temp**
Alt Shift:	**Unmapped**		
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 9:

	Action	Content	Label
Alt:	**Unmapped**		
Alt Shift:	**Send Text**	**U^M F^M T^M**	**Heater CK**
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Enter the following values for Key 0:

	Action	Content	Label
Alt:	**Send Text**	**#99990001REBOOT80^C**	**Reboot**
Alt Shift:	**Unmapped**		
Alt Ctrl:	**Unmapped**		
Alt Shift Ctrl:	**Unmapped**		

Click **Save As** and save as RSOIS.KEY (Save the location for future reference).

Click **OK** to exit the Meta Key Editor.

Press **Esc** to return to the data screen.

Meta Key Summary

Function	Key Stroke
Enter the RPU (SDL) via the Base Station (**Required Keystroke for RSOIS interrogation**)	Alt-1
Open/set RPU time 1	Alt-Shift-1
Wind sensor label	Alt-Shift-Ctrl-1
Open the SDL or Base Station (**This keystroke allows access to any ZENO®**)	Alt-2
Open/set RPU time 2	Alt-Shift-2
Bit Message Output Check (RPU)	Alt-3
Open/set RPU time 3	Alt-Shift-3
Sample Period Check (RPU)	Alt-4
Memory Capacity Check (RPU)	Alt-5
Data Receive from RPU (**Additional Keystrokes Required**)	Alt-6
RPU Battery Voltage Check	Alt-7
RPU Internal Temperature	Alt-8
RPU Heater Check	Alt-Shift-9
Reboot the SDL or Base Station (**This keystroke allows REBOOT of any ZENO®**)	Alt-0

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APPENDIX E

BASE STATION SETUP

The Base Station and Remote Processing Unit (RPU) are equipped to communicate with each other by data radio. It is essential to properly configure the Base Station to properly receive data transmissions from the RPU. It is also necessary that personal or laptop computer terminal communications have been established with the Base Station and that the Primary ID and Secondary ID of the RPU are known. Both the RPU and Base Station must be configured and functional.

The RPU transmits data messages at a rate of every five seconds. These messages are transmitted via radio and are received at the Base Station regardless of the proper or improper ID settings of the Base Station. By monitoring the data available on the RS232 connection at the Base Station, a data transmission approximately every five to six seconds looking like the following example should display:

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

The string of numbers immediately following the pound sign (#) are a pair of four digit IDs (shown in bold). The first four digit number is the Primary ID of the Base Station. This number corresponds to the Secondary ID of the RPU.

#05110011

The second four digit number is the Secondary ID of the Base Station. This number corresponds to the Primary ID of the RPU.

#0511**0011**

NOTE: The following steps set the Base Station's IDs and serial sensor "Destination Address". To setup the Base Station, substitute the installing site's RPU secondary ID in place of the pound signs and the RPU primary ID in place of the question marks.

Type **U** then **5Enter** to display the User Menu.

```
USER MENU
(C) Communications Menu          (T) Test Menu
(F) System Functions Menu        (Z) Zeno Program Menu
(S) Sample Period Menu           (Q) Quit
(D) Data Retrieval Menu          (H) Help
```

Type **F** (space) **C1/###** (space) **C2/??** (space) **U** (space) **Z** and **<enter>** to display the following screen:

```
Enter Administrator Password:
```

Type **zeno** then **5Enter** for the ZENO Program Menu.

```
Waiting for all data acquisition tasks to finish . . .

ZENO PROGRAM MENU
(S) Sensor Menu                          (M) Memory Management Menu
(P) Process Menu                         (W) Password Menu
(D) Data Output Menu                     (R) Reset System
(T) Sensor Timing Loop Menu              (E) Save Parameters To EEPROM
(O) Output Message Timing Menu           (U) User Menu
(L) System Load Menu                     (Q) Quit
(G) General Serial Script Menu           (H) Help
```

Type **S** (space) **J2** (space) **C17/??** (space) **Z** (space) **E** (space) **Q** then **5Enter**. This will generate the following view:

```
Verifying parameters can be stored in EEPROM . . .
Saving parameters to EEPROM . . .
Saving sensor lists to EEPROM . . .
Saving process lists to EEPROM . . .
Saving data output lists to EEPROM . . .
Saving repeater lists to EEPROM . . .
Saving general serial scripts to EEPROM . . .
Saving constants to EEPROM . . .
### out of 8192 bytes used in EEPROM.
Total EEPROM Writes = ##, EEPROM Checksum = ###.
Checking Scan List records ...

Estimated minimum time required for the ZENO-3200 (NO ANALOG) to collect
data from all sensors at least once is 0 seconds.

Exiting user interface.

#05110011
01/02/22,15:58:00,11,9,94,0,12,0,-6.0,-9.1,76,0,0,0,46
#05110011
01/02/22,15:58:30,11,10,95,0,13,0,-6.0,-9.1,76,0,0,0,91
```

The display is now active.

APPENDIX F

SAVING BASE STATION CONFIGURATION FILES

Enter **Procomm** to display the following output.

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

Type **U** then **5Enter** to display the *User Menu*.

```
USER MENU
(C) Communications Menu              (T) Test Menu
(F) System Functions Menu            (Z) Zeno Program Menu
(S) Sample Period Menu               (Q) Quit
(D) Data Retrieval Menu                  (H) Help
```

Type **Z** then **5Enter** to display:

```
Enter Administrator Password:
```

Type **zeno** then **5Enter** to display the *ZENO Program Menu*.

```
Waiting for all data acquisition tasks to finish . . .

ZENO PROGRAM MENU
(S) Sensor Menu                          (M) Memory Management Menu
(P) Process Menu                         (W) Password Menu
(D) Data Output Menu                     (R) Reset System
(T) Sensor Timing Loop Menu              (E) Save Parameters To EEPROM
(O) Output Message Timing Menu           (U) User Menu
(L) System Load Menu                     (Q) Quit
(G) General Serial Script Menu           (H) Help
```

Type **L** (space) **T** and **5Enter** to display the following output:

```
Turn On Host Computer File Capture Now.
Enter Any Key To Continue.
```

Select **Data** * **Capture File** as shown in figure 30.

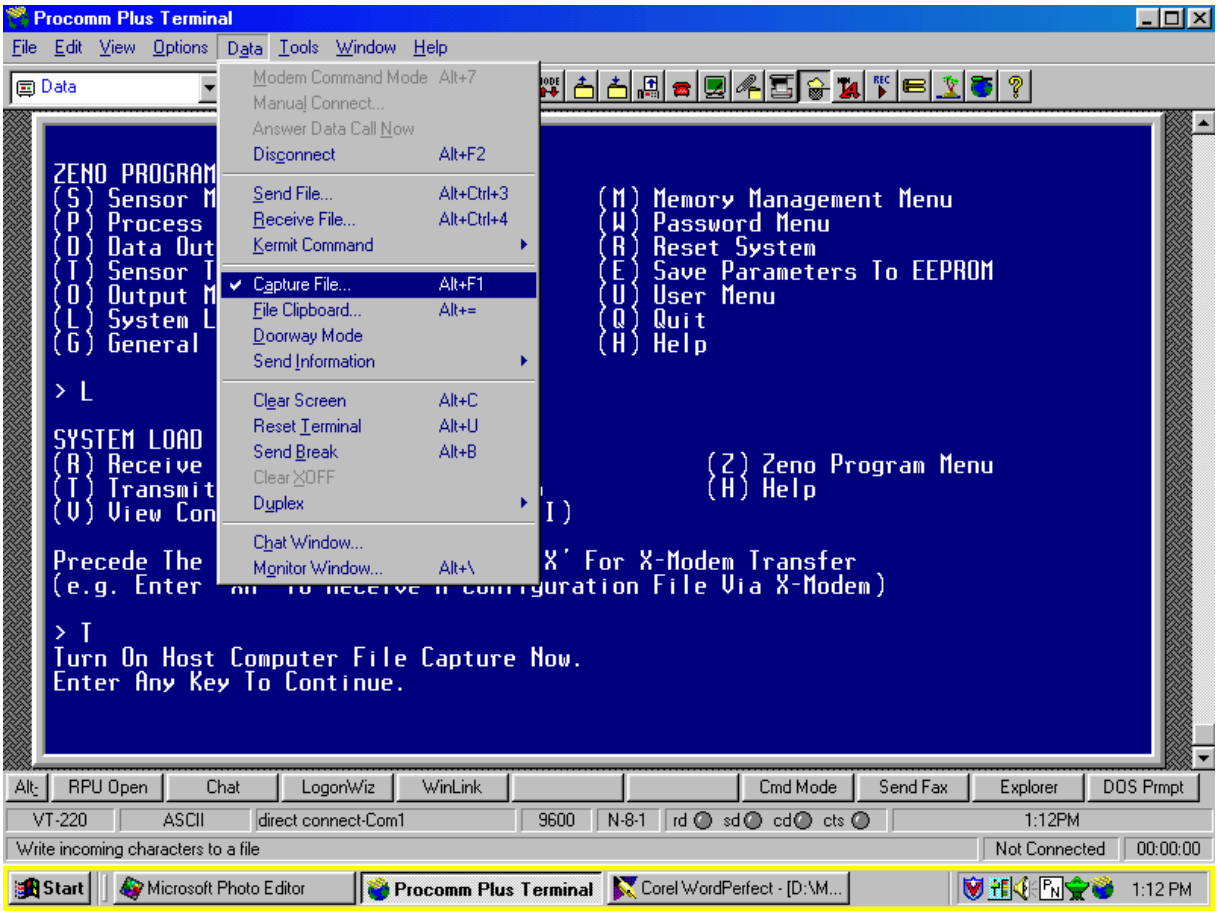

Figure 30: Data * Capture File Data * Capture File

Press **5Enter**. This displays output similar to the following:

```
* Zeno 3200 System Setup File
* Program Version And Date: ZENO-3200 (NO ANALOG) ZENOSOFT
V1.955-BS-2178-1.1 Sep 22 2000 08:49:33 CS 30B0
* (C)opyright 1995-2000, Coastal Environmental Systems, Seattle, WA,
USA.
* Setup File Date And Time: 35/12/13 18:32:03
PARAM1 6 0 5 2 3 4 511 11 9600 9600
PARAM2 9600 0 0 0 0 1 2 0 0 0
PARAM3 16777 0 60 18 0 12 0 0 1 2
PARAM4 2 2 0 0 1 3276800 0 -1 5 0
PARAM5 3 0 0 0 1000 0 0 0 0 0
PARAM6 0 3 3 915278400 50336144 151 196608 0 1 0
PARAM7 151 0 1280 0 10000 -1 -1 0 10 1
PARAM8 42 0 0 0 0 0 0 0 0 0
```

```
PARAM9 0 0 0 0 0 0 5 0 0 0
PARAM10 0 0 9 0
PARAM11 "NONE" "NONE" "NONE" "NONE" "NONE" "NONE" "" "ZENO" "" "NONE"
PARAM12 "---" "ZENO-3200-Reset" "Real-Time-Clock-Suspect"
"Logging-Memory-Initialized" "Serial-Sensor-COM-Failure"
"EEPROM-Suspect" "18-Bit-ADC-Suspect" "12-Bit
-ADC-Suspect" "Temperature-Clock-Adjustment" ""
PARAM13 "" "" "" "" "" "" "" "" "" ""
PARAM14 "" "" "" "" "" "" "" "" "" ""
PARAM15 "" "" ""
REPEAT1 -1 -1 -1 -1 -1 -1 -1 -1
CONSTANT1 0 0 0 0 0 0 0 0 0 0
CONSTANT2 0 0 0 0 0 0 0 0 0 0
GSI 1 NO_COMMAND
SENSOR 8 "" 0 0 0 0 0 0 10 1 1 1 0 1e-32 1 0 0 0 0 0 0 0 0 0 S0.1
SENSOR 19 "" 0 0 0 0 0 0 0 11 0 1 0 1 0 0 11 0 9600 0 0 0 0 0 S0.1
PROCESS 1 1 "" S0.1
DATA 6 1 "<0E><0C>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "ID" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "RemoteID" S2.1 0 4 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>20<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "SP" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "greater<0D><0A>" S2.2 0 3 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>27<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "WD" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "WndDir" S2.3 0 3 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>33<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "AT" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "AirTemp" S2.7 1 5 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>40<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "GU" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "WndGust" S2.10 0 3 1 P1.1 P1.1 P1.1
DATA 10 1 "GustFlag" S2.11 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "*" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 11 1 "" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>47<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "WC" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "WndCond" S2.4 0 3 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>53<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "DP" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "DewPt" S2.8 1 5 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>60<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "PK" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "WndPeak" S2.5 0 3 1 P1.1 P1.1 P1.1
DATA 10 1 "PeakFlag" S2.6 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "*" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 11 1 "" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "<10>73<20>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 6 1 "RH" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 7 1 "RelHumid" S2.9 1 5 1 P1.1 P1.1 P1.1
DATA 7 2 "string" S2.S1 0 100 1 P1.1 P1.1 P1.1
DATA 6 2 "<0D><0A>" P1.1 0 0 1 P1.1 P1.1 P1.1
* !!SYSTEM TRANSFER COMPLETE.
*Turn Off File Capture Now.
*Enter Any Key To Continue.
EOF
```

Select **Data** * **Capture File**, and click to turn off *File Capture*.
Press **5Enter** to access the *System Load Menu*.

```
SYSTEM LOAD MENU
(R) Receive Configuration From Host            (Z) Zeno Program Menu
(T) Transmit Configuration From Zeno           (H) Help
(V) View Configuration & Menus (ASCII)

Precede The R Or T Command With An 'X' For X-Modem Transfer
(e.g. Enter 'XR' To Receive A Configuration File Via X-Modem)
```

Type **Z** (space) **U** (space) **Q** then **5Enter** to display the following output.

```
Checking Scan List records ...
Estimated minimum time required for the ZENO-3200 (NO ANALOG) to collect
data from all sensors at least once is 0 seconds.
Exiting user interface.
```

And return to:

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

APPENDIX G

SAVING RPU CONFIGURATION FILES

Enter **Procomm** to display the following output.

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

Type **Alt 1**. The following output displays.

```
Waiting for COM port 1.  Press any key to exit...-
*** Entering Terminal Mode on COM Port 1 ***
Press <ESC> on this terminal to exit.
NOTE: Data collection has been halted.
```

Type **U** then **5Enter** to display the *User Menu*.

```
USER MENU
(C) Communications Menu             (T) Test Menu
(F) System Functions Menu           (Z) Zeno Program Menu
(S) Sample Period Menu              (Q) Quit
(D) Data Retrieval Menu             (H) Help
```

Type **Z** then **5Enter** to display:

```
Enter Administrator Password:
```

Type **zeno** then **5Enter** for the *ZENO Program Menu*.

```
Waiting for all data acquisition tasks to finish . . .

ZENO PROGRAM MENU
(S) Sensor Menu                          (M) Memory Management Menu
(P) Process Menu                         (W) Password Menu
(D) Data Output Menu                     (R) Reset System
(T) Sensor Timing Loop Menu              (E) Save Parameters To EEPROM
(O) Output Message Timing Menu           (U) User Menu
(L) System Load Menu                     (Q) Quit
(G) General Serial Script Menu           (H) Help
```

NOTE: The next step verifies the RPU has seven sensors, the Base Station has two sensors, and ensures communication is with the RPU.

If communication is not with the RPU, start over by typing **Q** and then go back to the beginning of this appendix.

Type **S** then **5Enter** for the *Sensor Menu*.

```
SENSOR MENU
(Cn/m) Change Item n To Value m                (Jn) Jump To Record n
(A)    Insert After This Record                (N)  Go To Next Record
(B)    Insert Before This Record               (P)  Go To Previous
                                               Record
(X)    Cut Record to Clipboard                 (XA) Delete ALL Records
(C)    Copy Record To Clipboard                (Z)  Zeno Program Menu
(V)    Paste Record From Clipboard             (H)  Help
(Sn/m) Search Item n for Value m

Sensor Items for Record 1 of è:                                        7
Item  1: Sensor Type Code                 1 (12-bit Analog to Digital)
Item  2: Sensor Name                      INTEMP
Item  3: Sensor Input Channel             INTERNAL TEMPERATURE SENSOR
Item  6: Switched Power Code              0 (NO SWITCHED POWER)
Item  7: Sensor Excitation Voltage Code   0 (NO EXCITATION VOLTAGE)
Item  8: Switched Excitation Return       0
Item  9: Switched Power Warmup Time       0
Item 10: Sensor Sample Count              1
Item 11: Maximum Sensor Readings          1
Item 12: Sensor Timing Loop               2 (1.0 seconds)
Item 13: Conversion Coefficient A         0
Item 14: Conversion Coefficient B         1
Item 15: Conversion Coefficient C         0
```

Type **Z** then **5Enter** to return to the *Zeno Program* Menu.

```
ZENO PROGRAM MENU
(S) Sensor Menu                           (M) Memory Management Menu
(P) Process Menu                          (W) Password Menu
(D) Data Output Menu                      (R) Reset System
(T) Sensor Timing Loop Menu               (E) Save Parameters To EEPROM
(O) Output Message Timing Menu            (U) User Menu
(L) System Load Menu                      (Q) Quit
(G) General Serial Script Menu            (H) Help
```

Type **L** (space) **T** then **5Enter** to display the following output:

```
Turn On Host Computer File Capture Now.
Enter Any Key To Continue.
```

Select Data, then Capture File.

Press **5Enter**. This displays output similar to the following:

```
* Zeno 3200 System Setup File
* Program Version And Date: ZENO-3200 using ZENOSOFT V1.952-2178-1.1 Sep
19 2000
 09:51:12 CS 251D
* (C)opyright 1995-2000, Coastal Environmental Systems, Seattle, WA,
USA.
* Setup File Date And Time: 01/02/01 18:23:46
PARAM1 5 0 5 2 4 6 11 511 9600 9600
PARAM2 9600 0 0 0 0 3 3 0 0 0
```

```
PARAM3 16777 0 60 18 0 10 0 0 0 2
PARAM4 2 2 0 0 1 3276685 0 -1 5 0
PARAM5 0 0 0 0 300 0 0 0 0 0
PARAM6 0 0 0 935744400 50336144 151 196608 0 1 0
PARAM7 151 0 1280 0 10000 -1 -1 0 10 1
PARAM8 42 0 0 0 0 0 0 0 0 0
PARAM9 0 0 0 0 0 0 5 0 100 100
PARAM10 0 0 0 0
PARAM11 "NONE" "NONE" "NONE" "NONE" "NONE" "NONE" "" "ZENO" "" ""
PARAM12 "999" "ZENO-3200-Reset" "Real-Time-Clock-Suspect"
"Logging-Memory-Initialized" "Serial-Sensor-COM-Failure"
"EEPROM-Suspect" "18-Bit-ADC-Suspect" "12-Bit
-ADC-Suspect" "Temperature-Clock-Adjustment" ""
PARAM13 "" "" "" "" "" "" "" "" "" ""
PARAM14 "" "" "" "" "" "" "" "" "" ""
PARAM15 "" "" ""
REPEAT1 -1 -1 -1 -1 -1 -1 -1 -1
CONSTANT1 0 20 0 0 100 0 0 0 0 0
CONSTANT2 0 0 0 0 0 0 0 0 0 0
GSI 1 STRING 1 ( 50 )
GSI 1 SEND "\B "
GSI 1 WAIT 75
GSI 1 SEND "%1sXH1!", sID
GSI 1 RECEIVE 500, "%s", S1
GSI 1 SEND "\B "
GSI 1 WAIT 75
GSI 1 SEND "%1sXU1!", sID
GSI 1 RECEIVE 500, "%s", S1
GSI 1 SEND "\B "
GSI 1 WAIT 75
GSI 1 SEND "%1sXQ1;3.3;3;0005!", sID
GSI 1 RECEIVE 500, "%s", S1
SENSOR 1 "INTEMP" 3 0 0 0 0 0 0 1 1 2 0 1 0 0 0 0 0 0 0 0 0 0 S0.1
SENSOR 17 "Handar" 1 0 0 0 0 0 0 8 1 1 0 1 0 2 0 1 1200 0 0 0 0 0 S0.1
SENSOR 16 "InitHand" 1 0 0 0 0 0 0 1 1 4 0 1 0 0 0 1 1200 7 2 1 1 1 P3.1
SENSOR 2 "AT" 14 0 2 0 2 0 0 1 0 2 0 0.4 0 0 0 0 0 0 0 0 0 0 S0.1
SENSOR 2 "RH" 7 0 1 4 0 0 3 1 0 2 0 100 0 0 0 0 0 0 0 0 0 0 S0.1
SENSOR 8 "FLOW" 5 0 0 0 0 0 0 0 1 1 2 0 -1 1 0 0 0 0 0 0 0 0 0 S0.1
SENSOR 1 "BATTERY" 2 0 0 0 0 0 0 0 1 1 1 0 1 0 0 0 0 0 0 0 0 0 0 S0.1
PROCESS 3 8 "MissHndr" S2.1 0 0
PROCESS 1 12 "Prev" P1.1
PROCESS 5 3 "AddFlag" P1.1 P2.1
PROCESS 2 12 "AvgWS" S2.1 125 0 75 17 18
PROCESS 2 13 "AvgWD" S2.2 P4.1 6 60 75 0
PROCESS 3 2 "HeaterAL" S2.5 0.75 -1 20
PROCESS 5 2 "WS-2" P4.1 -2
PROCESS 5 13 "WS_LT_2" P7.1 P4.1 C10 P4.1
PROCESS 5 13 "wd_ws_2" P7.1 P5.1 C10 P5.1
PROCESS 3 15 "StatWind" S2.1 0.1 600 19
PROCESS 3 2 "flowbit" S6.1 1.5 0.5 12
PROCESS 4 1 "at" S4.1 0.001288 0.0002356 9.557e-08 4990 70 -60 10
PROCESS 1 3 "at_avg" P12.2 5 75 9
PROCESS 1 13 "at_valid" P13.7 P13.6 S0.1 S0.1 S0.1 S0.1 S0.1 S0.1 S0.1
S0.1 S0.1 S0.1 S0.1
PROCESS 3 15 "at_stc" P12.2 0.1 1800 11
PROCESS 3 2 "rhto05" S5.1 105 100 0
```

```
PROCESS 5 8 "105chk" P16.1 0 -1 1
PROCESS 3 2 "" P17.1 0.5 -0.5 14
PROCESS 5 13 "set100" P17.1 S5.1 S5.1 C5
PROCESS 3 2 "rh_oor" P19.1 105 0 15
PROCESS 1 13 "rh_inr" P20.1 P19.1 S0.1 S0.1 S0.1 S0.1 S0.1 S0.1 S0.1
S0.1 S0.1 S0.1 S0.1
PROCESS 1 3 "rh_avg" P21.1 5 75 13
PROCESS 1 13 "rh_valid" P22.7 P22.6 S0.1 S0.1 S0.1 S0.1 S0.1 S0.1 S0.1
S0.1 S0.1 S0.1 S0.1
PROCESS 3 15 "rh_stc" S5.1 0.1 1800 16
PROCESS 2 7 "dp_avg" P14.1 P23.1 S0.1
PROCESS 3 3 "HeaterON" S1.1 -30 -25 21 18 0 3
PROCESS 3 1 "BIT"
DATA 6 1,2 "<0D><0A>" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 3 1,2 "" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 4 1,2 "" P1.1 0 0 1 P1.1 P1.1 P1.1
DATA 9 1,2 "WS2r" P8.1 0 0 5 P1.1 P1.1 P1.1
DATA 9 1,2 "WD2r" P9.1 0 0 5 P1.1 P1.1 P1.1
DATA 9 1,2 "WC" P5.2 0 0 1 P1.1 P1.1 P1.1
DATA 9 1,2 "WPeak" P4.3 0 0 5 P1.1 P1.1 P1.1
DATA 9 1,2 "WPFlag" P4.5 0 0 1 P1.1 P1.1 P1.1
DATA 9 1,2 "T5Avg" P14.1 1 0 7 P1.1 P1.1 P1.1
DATA 9 1,2 "TD5Avg" P25.2 1 0 7 P1.1 P1.1 P1.1
DATA 9 1,2 "RH5Avg" P23.1 0 0 5 P1.1 P1.1 P1.1
DATA 9 1,2 "WGust" P4.2 0 0 5 P1.1 P1.1 P1.1
DATA 9 1,2 "WGFlag" P4.4 0 0 1 P1.1 P1.1 P1.1
DATA 9 1,2 "BIT" P27.L1 0 0 6 P1.1 P1.1 P1.1
DATA 8 1 "WSai" S2.1 0 0 5 P1.1 P1.1 P1.1
DATA 8 1 "WDai" S2.2 0 0 5 P1.1 P1.1 P1.1
DATA 1 1,2 "" P1.1 0 2 1 P1.1 P1.1 P1.1
* !!SYSTEM TRANSFER COMPLETE.
* Turn Off File Capture Now.
* Enter Any Key To Continue.
EOF
```

Select **Data** * **Capture File**, and click to turn off *File Capture*.

Press **5Enter** to access the *System Load Menu*.

```
SYSTEM LOAD MENU
(R) Receive Configuration From Host          (Z) Zeno Program Menu
(T) Transmit Configuration From Zeno         (H) Help
(V) View Configuration & Menus (ASCII)

Precede The R Or T Command With An 'X' For X-Modem Transfer
(e.g. Enter 'XR' To Receive A Configuration File Via X-Modem)
```

Type **Z** (space) **U** (space) **Q** then **5Enter**. The following output displays:

```
Checking Scan List records ...
Estimated minimum time required for the ZENO-3200 (NO ANALOG) to collect
data from all sensors at least once is 0 seconds.
Exiting user interface.
```

Press **Esc** to exit the RPU. The following output displays:

```
*** Exiting Terminal Mode on COM Port 1 ***

#00010511
OK,13
```

And return to:

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

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APPENDIX H

DATA RETRIEVAL

Enter **Procomm** to display the following output:

```
#05110011
01/02/01,18:49:25,11,6,310,1,11,0,8.3,-2.5,46,13,0,0,8,291,95
#05110011
01/02/01,18:49:30,11,6,307,1,11,0,8.3,-2.5,46,13,0,0,5,288,00
#05110011
01/02/01,18:49:35,11,7,307,1,11,0,8.3,-2.5,46,13,0,0,11,307,43
#05110011
01/02/01,18:49:40,11,7,309,1,11,0,8.3,-2.6,46,13,0,0,10,283,44
```

Press **Alt 1**. The following output displays.

```
Waiting for COM port 1.  Press any key to exit...-
*** Entering Terminal Mode on COM Port 1 ***
Press <ESC> on this terminal to exit.
NOTE: Data collection has been halted.
```

Type **U** then **5Enter** to display the *User Menu*.

```
USER MENU
(C) Communications Menu             (T) Test Menu
(F) System Functions Menu           (Z) Zeno Program Menu
(S) Sample Period Menu              (Q) Quit
(D) Data Retrieval Menu             (H) Help
```

Type **D** then **5Enter** to display the *Data Retrieval Menu*.

```
DATA RETRIEVAL MENU
(A)  Show Records AFTER Specified Time  (F) Flash Memory Information
(B)  Show Records BETWEEN Timespan      (D) Delete All Data Records
(Ln) Show LAST n Records                (N) Number Of Records Logged
(*)  Show ALL Data Records              (U) User Menu
(@n) Show n Unmarked Records            (Q) Quit
(M)  Mark Recently Shown Data           (H) Help
(C)  Compute Data Logging Capacity

Precede Any "Show Data" Command With An 'X' For X-Modem Transfer
(e.g. Enter 'X*' To Send All Data Sets Via X-Modem)
```

Type **A** then **5Enter**

At the prompt:

```
Enter data search start time:
```

Type the **YY/MM/DD** (space) **HH:MM:SS** and **5Enter**.

At the prompt:

```
Enter number of data sets to display:
```

Type **100** then **5Enter**

The following output displays:

```
#05110011
01/02/01,18:49:25,11,6,310,1,11,0,8.3,-2.5,46,13,0,0,8,291,95
#05110011
01/02/01,18:49:30,11,6,307,1,11,0,8.3,-2.5,46,13,0,0,5,288,00
#05110011
01/02/01,18:49:35,11,7,307,1,11,0,8.3,-2.5,46,13,0,0,11,307,43
#05110011
01/02/01,18:49:40,11,7,309,1,11,0,8.3,-2.6,46,13,0,0,10,283,44

DATA RETRIEVAL MENU
(A)  Show Records AFTER Specified Time    (F) Flash Memory Information
(B)  Show Records BETWEEN Timespan        (D) Delete All Data Records
(Ln) Show LAST n Records                  (N) Number Of Records Logged
(*)  Show ALL Data Records                (U) User Menu
(@n) Show n Unmarked Records              (Q) Quit
(M)  Mark Recently Shown Data             (H) Help
(C)  Compute Data Logging Capacity

Precede Any "Show Data" Command With An 'X' For X-Modem Transfer
(e.g. Enter 'X*' To Send All Data Sets Via X-Modem)
```

Type **B** then **5Enter**.

At the prompt:

```
Enter data search start time:
```

Type **YY/MM/DD** (space) **HH:MM:SS** then **5Enter**.

At the prompt:

```
Enter data search stop time:
```

Type **YY/MM/DD** (space) **HH:MM:SS** then **5Enter**.

The display returns to:

```
#05110011
01/02/01,18:50:25,11,6,296,0,11,0,8.2,-2.8,45,13,0,0,1,207,90
#05110011
01/02/01,18:50:30,11,6,298,0,11,0,8.2,-2.8,45,13,0,0,1,347,93

DATA RETRIEVAL MENU
(A)  Show Records AFTER Specified Time    (F) Flash Memory Information
(B)  Show Records BETWEEN Timespan        (D) Delete All Data Records
(Ln) Show LAST n Records                  (N) Number Of Records Logged
(*)  Show ALL Data Records                (U) User Menu
(@n) Show n Unmarked Records              (Q) Quit
```

```
(M)  Mark Recently Shown Data             (H) Help
(C)  Compute Data Logging Capacity

Precede Any "Show Data" Command With An 'X' For X-Modem Transfer
(e.g. Enter 'X*' To Send All Data Sets Via X-Modem)
```

Type **C** then **5Enter** to compute data logging capacity.

```
Total Data Logging Memory (bytes)         = 915700
Maximum Number Of Data Records            = 21295
Size of Each Data Record                  = 43
Maximum Data Time Span (d:hh:mm:ss)       = 1:05:34:35 [Min 24 Hrs Data]
Time Before Next Wrap (d:hh:mm:ss)        = 0:11:47:50
Logging Memory Has Wrapped                = YES

DATA RETRIEVAL MENU
(A)  Show Records AFTER Specified Time    (F) Flash Memory Information
(B)  Show Records BETWEEN Timespan        (D) Delete All Data Records
(Ln) Show LAST n Records                  (N) Number Of Records Logged
(*)  Show ALL Data Records                (U) User Menu
(@n) Show n Unmarked Records              (Q) Quit
(M)  Mark Recently Shown Data             (H) Help
(C)  Compute Data Logging Capacity

Precede Any "Show Data" Command With An 'X' For X-Modem Transfer
(e.g. Enter 'X*' To Send All Data Sets Via X-Modem)
```

Type **L3** then **5Enter**.

NOTE: This selection is an example to display three records.

```
#05110011
01/02/01,18:51:50,11,3,299,0,8,0,8.2,-2.3,47,13,0,0,4,203,43
#05110011
01/02/01,18:51:55,11,3,295,0,8,0,8.2,-2.3,47,13,0,0,4,219,51
#05110011
01/02/01,18:52:00,11,3,291,0,8,0,8.2,-2.3,47,13,0,0,3,231,31

DATA RETRIEVAL MENU
(A)  Show Records AFTER Specified Time    (F) Flash Memory Information
(B)  Show Records BETWEEN Timespan        (D) Delete All Data Records
(Ln) Show LAST n Records                  (N) Number Of Records Logged
(*)  Show ALL Data Records                (U) User Menu
(@n) Show n Unmarked Records              (Q) Quit
(M)  Mark Recently Shown Data             (H) Help
(C)  Compute Data Logging Capacity

Precede Any "Show Data" Command With An 'X' For X-Modem Transfer
(e.g. Enter 'X*' To Send All Data Sets Via X-Modem)
```

Type **Q** then **5Enter**. The following output displays:

```
Exiting user interface.
```

And then return to the data display.

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APPENDIX I

WIND SENSOR COMMUNICATION AND INTERROGATION

Although pass through communication can be established with the Wind Sensor through the Base Station, it cannot be terminated without resetting the system at the RPU. Therefore, for this procedure communication should be established via COM 3 of the RPU (SDL).

At the *RPU*, enter **Procomm** to display:

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

Select **U** then **5 Enter** to display the *User Menu*.

```
USER MENU
(C) Communications Menu              (T) Test Menu
(F) System Functions Menu            (Z) Zeno Program Menu
(S) Sample Period Menu               (Q) Quit
(D) Data Retrieval Menu              (H) Help
```

Type **T** (space) **P** then **5 Enter** (Selecting **Alt-[Shift-Ctrl-1** can eliminate these key strokes) to display:

```
Enter the SDI-12 COM port (type COM2 rtn):

Waiting for SDI-12 COM port.  Press any key to exit...

Entering SDI-12 Pass through mode.  Press Esc to exit.
```

NOTE: When entering a SDI-12 command you need not append an exclamation mark (!).

```
Enter a SDI-12 command or an <ESC> to exit
```

Type **0I** (zero eye) then **5 Enter** [*ZER0(0) is the default SDI-12 Address, I = Identify*]

```
SDI-12 Command:  "0I!"
SDI-12 Response:  "011<20>HANDAR<20><20>425AHW<20>511<0D><0A>"
```

Response Key:
0 = Sensor address
11 = SDI-12 Version1.1..... U
<20> = Space
HANDAR = vendor ..... U
<20> = Space
<20> = Space
425AHW = Model #..... U
511 = Firmware version 5.11..... U
<0D> = CR
<0A> = LF

```
Enter a SDI-12 command or an <ESC> to exit
```

Type **0X?** then **5 Enter** [*ZER0(0) is the default SDI-12 Address, X? = Submode?*]

```
SDI-12 Command:  "0X?!"
SDI-12 Response:  "0+1+3+5<0D><0A>"
```

Response Key:
0 = Sensor address
+1 = Submode B..... U
+3 =
+5 =
<0D> = CR
<0A> = LF

Enter a SDI-12 command or an <ESC> to exit

Type **0X*** then **5 Enter** [*ZER0(0) is the default SDI-12 Address, X* = Current Units?*]

```
SDI-12 Command:  "0X*!"
SDI-12 Response:  "0+1<0D><0A>"
```

Response Key:
0 = Sensor address
+1 = KNOTS..... U
<0D> = CR
<0A> = LF

```
Enter a SDI-12 command or an <ESC> to exit
```

Type **0R0** then **5 Enter**

```
SDI-12 Command:  "0R0!"
SDI-12 Response:  "0+3.5+277+3.9+265+0+37.0+0.72+652.5<0D><0A>"
```

Response Key:
0 = Sensor address

+3.5 = 5-Second vector average wind speed
+277 = 5-Second vector average wind direction
+3.9 = Maximum vector average wind speed in last 5 seconds
+265 = Vector average wind direction of last 5 seconds maximum
+0 = Heater circuit GOOD..... U
+37.0 = Power supply voltage..... U
+0.72 = Heater current (Amps)..... U
+652.5 =
<0D> = CR
<0A> = LF

```
Enter a SDI-12 command or an <ESC> to exit
```

Press **Esc** to display:

```
*** Exiting Terminal Mode on COM Port 2 ***
```

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APPENDIX J

CHANGING SYSTEM TIME

J-1 GENERAL

System time is controlled by the RPU System Data Logger. Although the Base Station time can be changed, it is not reported, generally never seen, and has no battery backup. Thus, all time changes should be made to system time at the RPU (SDL).

System time can be changed either through the Base Station or by a direct connection to COM 3 port at the SDL. Systems with Fiber Optic Drivers (future capability) can change the system time by following the procedure for making the change through COM 3 port at the SDL.

NOTE: System communications timing, or the sample period of the system, makes changing the time a challenge because it requires the time data to be entered prior to the next radio sample. If the data does not reach the SDL within the next sample, the system communications are halted while the radio awaits a carriage return. With the communications halted, the carriage return is never received regardless of operator action at the Base Station. To avoid this problem the timing of the communications is slowed to allow users to set the time remotely.

J-2 TO CHANGE SYSTEM TIME THROUGH THE BASE STATION

Enter **Procomm** to display the following output.

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

Press **Alt 1** to display:

```
Waiting for COM port 1.  Press any key to exit...-
*** Entering Terminal Mode on COM Port 1 ***
Press <ESC> on this terminal to exit.
NOTE: Data collection has been halted.

#05110011
00/01/01,00:15:40,11,4,267,0,5,0,-4.2,-6.1,85,0,0,0,28
#05110011
00/01/01,00:15:45,11,3,267,0,5,0,-4.2,-6.1,85,0,0,0,32
```

Press **Alt** [**Shift** 1 for:

```
#00010011
OK,08                                                (Wait for this response!!)

#05110011
00/01/01,00:15:56,11,3,268,0,5,0,-4.2,-6.1,85,0,0,0,35
```

Press **Alt [Shift 2** for:

```
#00010011
OK,08                                          (Wait for this response!!)
```

Press **Alt [Shift 3** for the *User Menu*.

```
USER MENU
(C) Communications Menu             (T) Test Menu
(F) System Functions Menu           (Z) Zeno Program Menu
(S) Sample Period Menu              (Q) Quit
(D) Data Retrieval Menu             (H) Help

> F

SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m          (I) Contact Information
(S)    System Date And Time              (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature    (U) User Menu
(V)    Program Version                   (Q) Quit
(K)    Constants Menu                    (H) Help
(B)    BIT Names Menu

Item  1:  11            (Primary Unit/Experiment ID)
Item  2:  511           (Secondary Unit/Experiment ID)
Item  3:  3             (Data Dump Format)
Item  4:  3             (Real Time Output Format)
Item  5:  0             (Add Compass To Vane)
Item  6:  0             (Compass Offset)
Item  7:  0             (Barometer Elevation)
Item  8:  999           (Bad Sensor Value Replace)

> S

Current Date and Time:   00/01/01 00:16:11
Enter the new Date and Time:
```

Enter the new **GMT** date and time as **YY/MM/DD** (space) **HH:MM:SS** then **5 Enter**

```
Note: Next sample interval begins in 41 minutes and 30 seconds.
```

The *System Functions Menu* returns.

```
SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m          (I) Contact Information
(S)    System Date And Time              (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature    (U) User Menu
(V)    Program Version                   (Q) Quit
(K)    Constants Menu                    (H) Help
(B)    BIT Names Menu

Item  1:  11            (Primary Unit/Experiment ID)
Item  2:  511           (Secondary Unit/Experiment ID)
Item  3:  3             (Data Dump Format)
Item  4:  3             (Real Time Output Format)
Item  5:  0             (Add Compass To Vane)
Item  6:  0             (Compass Offset)
Item  7:  0             (Barometer Elevation)
```

```
Item  8:  999          (Bad Sensor Value Replace)
```

Type **Q** then **5 Enter** for:

```
Exiting user interface.
```

NOTE: It is optional to reboot the RPU (SDL).

Press **Alt 0** to reboot the *RPU*.

```
#00010011
OK,08                                    (REBOOT - Wait for this response!!)

ZENO-3200 Flash-Loader Application
Version:  V1.20  Sep 21 2000 14:38:48

Watchdog Reset
```

Press **Esc** to exit the RPU:

```
*** Exiting Terminal Mode on COM Port 1 ***

#00010511
OK,13
```

J-3 TO CHANGE SYSTEM TIME AT THE RPU

Enter **Procomm** to display the following screen.

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

Press **Alt [Shift 3** for the *User Menu*.

```
USER MENU
(C) Communications Menu              (T) Test Menu
(F) System Functions Menu            (Z) Zeno Program Menu
(S) Sample Period Menu               (Q) Quit
(D) Data Retrieval Menu              (H) Help

> F

   SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m          (I) Contact Information
(S)    System Date And Time              (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature    (U) User Menu
(V)    Program Version                   (Q) Quit
(K)    Constants Menu                    (H) Help
(B)    BIT Names Menu

Item  1:  11           (Primary Unit/Experiment ID)
Item  2:  511          (Secondary Unit/Experiment ID)
Item  3:  3            (Data Dump Format)
```

```
Item  4:  3             (Real Time Output Format)
Item  5:  0             (Add Compass To Vane)
Item  6:  0             (Compass Offset)
Item  7:  0             (Barometer Elevation)
Item  8:  999           (Bad Sensor Value Replace)

> S

Current Date and Time:   00/01/01 00:16:11
Enter the new Date and Time:
```

Enter the new **GMT** date and time as **YY/MM/DD** (space) **HH:MM:SS** then 5 **Enter**

```
Note: Next sample interval begins in 41 minutes and 30 seconds.
```

The *System Functions Menu* returns.

```
   SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m          (I) Contact Information
(S)    System Date And Time              (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature    (U) User Menu
(V)    Program Version                   (Q) Quit
(K)    Constants Menu                    (H) Help
(B)    BIT Names Menu

Item  1:  11            (Primary Unit/Experiment ID)
Item  2:  511           (Secondary Unit/Experiment ID)
Item  3:  3             (Data Dump Format)
Item  4:  3             (Real Time Output Format)
Item  5:  0             (Add Compass To Vane)
Item  6:  0             (Compass Offset)
Item  7:  0             (Barometer Elevation)
Item  8:  999           (Bad Sensor Value Replace)
```

Type **Q** and 5**Enter** to exit.

```
Exiting user interface.
#05110011
01/02/27,13:21:05,11,999,999,0,999,0,999,999,999,999,0,11100,24
#05110011
01/02/27,13:21:15,11,2,245,0,3,0,999,999,999,0,0,1100,96
```

APPENDIX K

CHECKING RPU DATA

Enter **Procomm** to display the following screen.

```
#05110011
01/02/22,16:05:26,11,999,999,0,999,0,999,999,999,999,0,91108,43
#05110011
01/02/22,16:05:41,11,999,999,0,999,0,999,999,999,999,0,1108,83
```

Press **Alt 1** to display:

```
Waiting for COM port 1.  Press any key to exit...-
*** Entering Terminal Mode on COM Port 1 ***
Press <ESC> on this terminal to exit.
NOTE: Data collection has been halted.
```

Type **U** then **5Enter** to display the *User Menu*.

```
USER MENU
(C) Communications Menu              (T) Test Menu
(F) System Functions Menu            (Z) Zeno Program Menu
(S) Sample Period Menu               (Q) Quit
(D) Data Retrieval Menu              (H) Help
```

Type **T** then **5Enter** for the *Test Menu*.

```
TEST MENU
(Rx,y) Display Sensors x-y RAW Data    (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data    (P)  SDI-12 Pass-Through Mode
(Cx)   Calibrate Sensor Record x          (U)  User Menu
(Vx)   View Process Record x              (Q)  Quit
(D)    View Data Collection Counters      (H)  Help
(B)    Display BIT Status
```

Type **S7,7** then **5Enter** to display: **(From Sensor Configuration File/BATTERY)**

```
Note: Hit any key to halt output.
BATTERY
13.6238
13.6238
13.6160
13.6160
13.6160
13.6160        13.8 vDC ± .5
13.6160
13.6003
13.6003
13.6003
13.6003
13.6003
13.6707
```

Press **5Enter** for the *Test Menu*.

```
TEST MENU
(Rx,y) Display Sensors x-y RAW Data    (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data (P)  SDI-12 Pass-Through Mode
(Cx)   Calibrate Sensor Record x       (U)  User Menu
(Vx)   View Process Record x           (Q)  Quit
(D)    View Data Collection Counters   (H)  Help
(B)    Display BIT Status
```

Type **S1,1** then **5Enter** to display: **(From Sensor Configuration File/INTERNAL TEMP)**

```
Note: Hit any key to halt output.
INTEMP
21.7224
21.7224
21.7224
21.7224
21.7224
21.7224
21.7224
21.7224
21.7224
21.8219
21.7224
```

Press **5Enter** for the *Test Menu*.

```
TEST MENU
(Rx,y) Display Sensors x-y RAW Data    (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data (P)  SDI-12 Pass-Through Mode
(Cx)   Calibrate Sensor Record x       (U)  User Menu
(Vx)   View Process Record x           (Q)  Quit
(D)    View Data Collection Counters   (H)  Help
(B)    Display BIT Status
```

Type **B** then **5Enter** for: (INTERPRET **BIT** STATUS)

```
Current Built-In-Test (BIT) Bits that are set:

Bit  9: Air_Temperature_Invalid_Range [Normal at Start-Up]
Bit 13: Relative_Humidity_Invalid_Range [Normal at Start-Up]

TEST MENU
(Rx,y) Display Sensors x-y RAW Data    (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data (P)  SDI-12 Pass-Through Mode
(Cx)   Calibrate Sensor Record x       (U)  User Menu
(Vx)   View Process Record x           (Q)  Quit
(D)    View Data Collection Counters   (H)  Help
(B)    Display BIT Status
```

Type **U** then **5Enter** to return to the *User Menu*.

```
USER MENU
(C) Communications Menu             (T) Test Menu
(F) System Functions Menu           (Z) Zeno Program Menu
(S) Sample Period Menu              (Q) Quit
(D) Data Retrieval Menu             (H) Help
```

Type **T** (space) **B** then **5Enter** to display:

[*Entering more then one command to do the same job*]

```
Current Built-In-Test (BIT) Bits that are set:


TEST MENU
(Rx,y) Display Sensors x-y RAW Data    (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data (P)  SDI-12 Pass-Through Mode
(Cx)   Calibrate Sensor Record x       (U)  User Menu
(Vx)   View Process Record x           (Q)  Quit
(D)    View Data Collection Counters   (H)  Help
(B)    Display BIT Status
```

Type **Q** then **5Enter** to exit *User Interface*.

```
Exiting user interface.
```

Press **Esc**

```
*** Exiting Terminal Mode on COM Port 1 ***

#00010511
OK,13
```

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APPENDIX L

BASE STATION AND RPU CONFIGURATION UPLOAD

L-1 PREREQUISITES

Configuration files must have been generated following the procedures in Appendix F, SAVING BASE STATION CONFIGURATION FILES and Appendix G, SAVING RPU CONFIGURATION FILES.

When uploading a **new** configuration(s) follow Appendix E, BASE STATION SETUP, to revise the Base Station IDs. When changing the IDs at the RPU, only the System Functions Menu need be changed. The sensor menu sequence

S (space) **J2** (space) **C17/??** (space) **Z** (space) **E** (space) **Q**

does not require editing.

L-2 CONFIGURATION UPLOAD

NOTE: The same procedures are followed to upload configuration files for the Base Station and RPU **except** that the **ALT 1** keystroke is required prior to uploading RPU files via the Base Station. The procedure is identical at COM 3 on the SDL or via the Fiber Optic Driver (future capability).

Enter **Procomm** to display the following screen.

```
#05110011
01/03/03,13:24:10,11,0,0,0,3,0,4.9,-2.7,57,0,0,0,80
```

Type U then 5 Enter to for the *User Menu*.

```
USER MENU
(C) Communications Menu            (T) Test Menu
(F) System Functions Menu          (Z) Zeno Program Menu
(S) Sample Period Menu             (Q) Quit
(D) Data Retrieval Menu            (H) Help
```

Type Z then 5 Enter to display:

```
Enter Administrator Password
```

Type zeno then 5 Enter to display the *ZENO Program Menu*:

```
Waiting for all data acquisition tasks to finish . . .
ZENO PROGRAM MENU
(S) Sensor Menu                        (M) Memory Management Menu
(P) Process Menu                       (W) Password Menu
(D) Data Output Menu                   (R) Reset System
(T) Sensor Timing Loop Menu            (E) Save Parameters To EEPROM
(O) Output Message Timing Menu         (U) User Menu
```

```
(L) System Load Menu                    (Q) Quit
(G) General Serial Script Menu          (H) Help
```

Type **L** (space) **XR** then **5 Enter**. At the prompt:

```
WARNING: The existing system setup will be lost.  Continue? (Y/N)
```

Type **Y** then **5 Enter**. The following output displays:

```
Ready to receive x-modem system configuration file.  Enter CONTROL-X to
abort. CCCCCCCCC
```

Select **Data**, **Send File**, see figure 31 and figure 32.

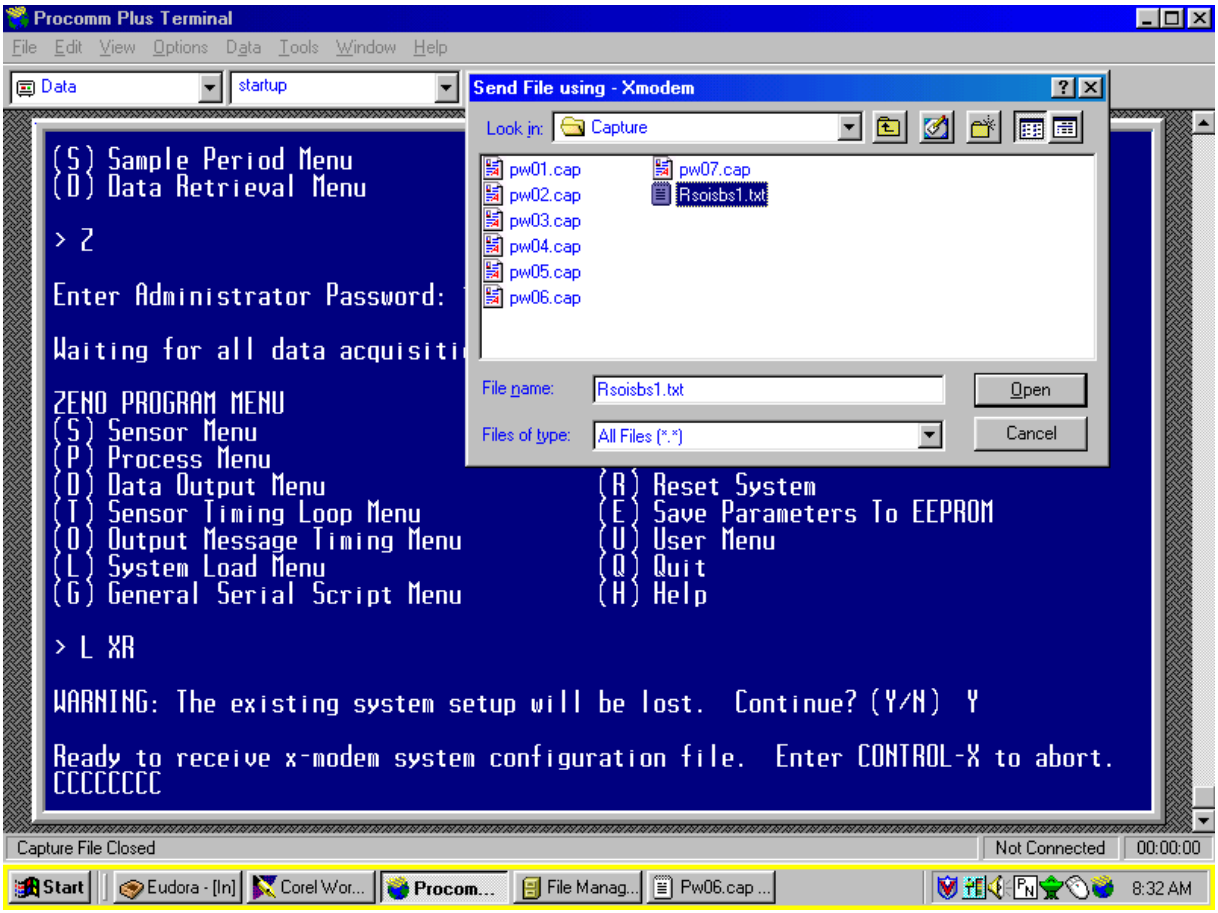

Figure 31: Data, Send File Example

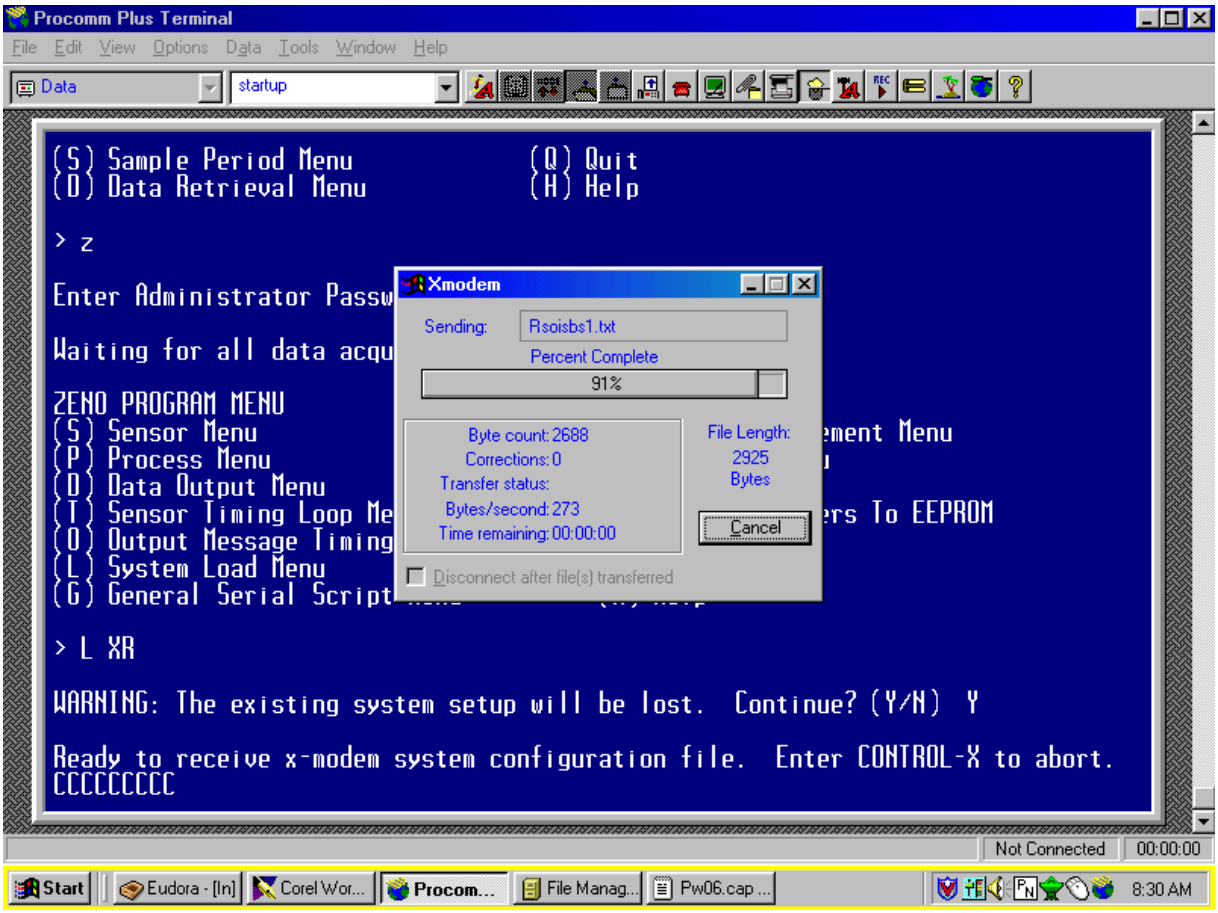

Figure 32: Data, Send File Example 2

The screen displays:

```
137   Parameters Loaded
      2     Sensors Loaded
      1     Processes Loaded
      35    Data Outputs Loaded
      8     Remote Repeater Addresses Loaded
      1      General Serial Scripts Loaded
      20    Constants Loaded

SYSTEM LOAD MENU
(R) Receive Configuration From Host                (Z) Zeno Program Menu
(T) Transmit Configuration From Zeno               (H) Help
(V) View Configuration & Menus (ASCII)

Precede The R or T command with an 'X' For X-Modem transfer (e.g. enter
'XR' to receive a configuration file via X-Modem).
```

Type **Z** (space) **E** (space) **Q** then **5 Enter** for:

```
Verifying parameters can be stored in EEPROM . . .
Saving parameters to EEPROM . . .
Saving sensor lists to EEPROM . . .

Saving process lists to EEPROM . . .
Saving data output lists to EEPROM . . .
Saving repeater lists to EEPROM . . .
Saving general serial scripts to EEPROM . . .
Saving constants to EEPROM . . .
787 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 12, EEPROM Checksum = 129.
Checking Scan List records ...

Estimated minimum time required for the ZENO-3200 (NO ANALOG) to
collect data from
all sensors at least once is 0 seconds.

Exiting user interface.

#05110011
01/03/03,13:25:00,11,0,0,0,3,0,4.9,-2.6,58,0,0,0,80
#05110011
01/03/03,13:27:50,11,2,335,0,5,0,4.8,-2.7,58,0,0,0,98
```

APPENDIX M

HEATER RELAY TEST

NOTE: Field sites should only perform heater relay test on systems (S200-1A) with an installed heater.

M-1 GENERAL

The purpose of the heater relay test is to verify the radio heater in the RPU is properly switched "ON" at temperatures below -30°C, is kept "ON" until the temperature rises to -25°C, and turned "OFF" at temperatures above -25°C.

The following may be locally reproduced and used to record measured values. Circled numbers are keyed to steps in the test.

Description	Internal Temperature Value	Measured AC Output	Expected Result
Original Internal Temperature (SDL)	ì	í	< 1 VAC
Low Set Point 1	-30.2/C	î	110-120 VAC
Low Set Point 2	-25.2/C	ï	110-120 VAC
Low Set Point 3	-15/C	ð	< 1 VAC
Reset Internal Temperature (SDL)	ì	ñ	< 1 VAC

U *Using a digital multi meter (DMM) check the AC voltage across the heater circuit. The value should be < 1 VAC.* í

M-2 HEATER RELAY TEST

The heater relay test is conducted from the RPU.

To start the test, establish communication via COM 3 port of the RPU (SDL).

Enter **Procomm** to display the following output:

```
#05110011
01/03/02,14:44:30,11,8,315,1,17,0,7.3,0.2,60,20,0,0,40
#05110011
01/03/02,14:44:35,11,8,316,1,17,0,7.3,0.2,60,20,0,0,46
```

Press **Alt [Shift 9** to display the *User Menu*.

```
USER MENU
(C) Communications Menu          (T) Test Menu
(F) System Functions Menu        (Z) Zeno Program Menu
(S) Sample Period Menu           (Q) Quit
```

```
(D) Data Retrieval Menu              (H) Help

>F

SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m           (I) Contact Information
(S)    System Date And Time               (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature     (U) User Menu
(V)    Program Version                    (Q) Quit
(K)    Constants Menu                     (H) Help
(B)    BIT Names Menu

Item  1:  11                  (Primary Unit/Experiment ID)
Item  2:  511                 (Secondary Unit/Experiment ID)
Item  3:  3                   (Data Dump Format)
Item  4:  3                   (Real Time Output Format)
Item  5:  0                   (Add Compass To Vane)
Item  6:  0                   (Compass Offset)
Item  7:  0                   (Barometer Elevation)
Item  8:  999                 (Bad Sensor Value Replace)

> T                           O  Note the Current Internal Temperature.

Internal Temperature: 18.3 C, 65.0 F.  ì
```

O *Record the internal temperature before changing:/C*

Enter temperature and scale (e.g., 22.5C or 75.2F): **- 30.2C** then 5 **Enter**.

U *Using a DMM again check the AC Voltage across the heater circuit. The value should now be 110-120 VAC.* Î

```
Writing data to EEPROM ...
4 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 26, EEPROM Checksum = 248.

SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m           (I) Contact Information
(S)    System Date And Time               (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature     (U) User Menu
(V)    Program Version                    (Q) Quit
(K)    Constants Menu                     (H) Help
(B)    BIT Names Menu

Item  1:  11            (Primary Unit/Experiment ID)
Item  2:  511           (Secondary Unit/Experiment ID)
Item  3:  3             (Data Dump Format)
Item  4:  3             (Real Time Output Format)
Item  5:  0             (Add Compass To Vane)
Item  6:  0             (Compass Offset)
Item  7:  0             (Barometer Elevation)
Item  8:  999           (Bad Sensor Value Replace)

> T

Internal Temperature: -30.1 C, -22.2 F.
```

Enter temperature and scale (e.g., 22.5C or 75.2F): **-25.2C** then **5 Enter**

U *Using a DMM again check the AC Voltage Across the heater Circuit. The value should still be 110-120 VAC.* ï

```
Writing data to EEPROM ...
4 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 27, EEPROM Checksum = 30.

SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m          (I) Contact Information
(S)    System Date And Time              (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature    (U) User Menu
(V)    Program Version                   (Q) Quit
(K)    Constants Menu                    (H) Help
(B)    BIT Names Menu

Item  1:  11           (Primary Unit/Experiment ID)
Item  2:  511          (Secondary Unit/Experiment ID)
Item  3:  3            (Data Dump Format)
Item  4:  3            (Real Time Output Format)
Item  5:  0            (Add Compass To Vane)
Item  6:  0            (Compass Offset)
Item  7:  0            (Barometer Elevation)
Item  8:  999          (Bad Sensor Value Replace)

>T

Internal Temperature: -25.2 C, -13.3 F.
```

Enter temperature and scale (e.g., 22.5C or 75.2F): **-15.0C** then **5 Enter**

U Using a DMM again check the AC Voltage Across the heater Circuit. The value should now be < 1 VAC.ð

```
Writing data to EEPROM ...
4 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 28, EEPROM Checksum = 3.

SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m          (I) Contact Information
(S)    System Date And Time              (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature    (U) User Menu
(V)    Program Version                   (Q) Quit
(K)    Constants Menu                    (H) Help
(B)    BIT Names Menu

Item  1:  11           (Primary Unit/Experiment ID)
Item  2:  511          (Secondary Unit/Experiment ID)
Item  3:  3            (Data Dump Format)
Item  4:  3            (Real Time Output Format)
Item  5:  0            (Add Compass To Vane)
Item  6:  0            (Compass Offset)
Item  7:  0            (Barometer Elevation)
Item  8:  999          (Bad Sensor Value Replace)
```

Select **T** then **5 Enter**.

```
Internal Temperature: -15.0 C,  5.1 F.
```

Enter temperature and scale (e.g., 22.5C or 75.2F): **##.#C** then **5 Enter**

O ##.#°C is the internal temperature noted at the beginning of this procedure. Ì

U *Using a DMM check the AC Voltage Across the heater Circuit.*
The value should be < 1 VAC. Unless the ambient temperature is less than -30.0° C. ñ

```
Writing data to EEPROM ...
4 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 29, EEPROM Checksum = 222.

SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m          (I) Contact Information
(S)    System Date And Time              (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature    (U) User Menu
(V)    Program Version                   (Q) Quit
(K)    Constants Menu                    (H) Help
(B)    BIT Names Menu

Item  1:  11           (Primary Unit/Experiment ID)
Item  2:  511          (Secondary Unit/Experiment ID)
Item  3:  3            (Data Dump Format)
Item  4:  3            (Real Time Output Format)
Item  5:  0            (Add Compass To Vane)
Item  6:  0            (Compass Offset)
Item  7:  0            (Barometer Elevation)
Item  8:  999          (Bad Sensor Value Replace)
```

Select **Q** then **5 Enter** to display:

```
Exiting user interface.

#05110011
01/03/02,14:47:25,11,11,314,1,24,0,7.3,0.0,59,24,0,180008,53
#05110011
01/03/02,14:47:30,11,12,314,1,24,0,7.3,0.0,60,24,0,0,85
#05110011
01/03/02,14:47:35,11,12,314,1,24,0,7.3,0.1,60,24,0,0,91
```

Press **Alt 8** for the *User Menu*. (RPU Internal Temperature Check)

```
USER MENU
(C) Communications Menu          (T) Test Menu
(F) System Functions Menu        (Z) Zeno Program Menu
(S) Sample Period Menu           (Q) Quit
(D) Data Retrieval Menu          (H) Help
```

Select **T** then **5 Enter** for the *Test Menu*.

```
TEST MENU
(Rx,y) Display Sensors x-y RAW Data    (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data (P)  SDI-12 Pass-Through Mode
```

```
(Cx)   Calibrate Sensor Record x       (U)  User Menu
(Vx)   View Process Record x           (Q)  Quit
(D)    View Data Collection Counters   (H)  Help
(B)    Display BIT Status
```

Type **S1,1** then **5 Enter** to display:

```
Note: Hit any key to halt output.

INTEMP
18.2097
18.2097
18.3090
18.3090
18.3090
18.3090
18.3090           Verify that the last temperature change was entered. ì
18.2097
18.2097
18.2097
18.2097
18.2097
```

Press **5 Enter** for the *Test Menu*.

```
TEST MENU
(Rx,y) Display Sensors x-y RAW Data    (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data (P)  SDI-12 Pass-Through Mode
(Cx)   Calibrate Sensor Record x       (U)  User Menu
(Vx)   View Process Record x           (Q)  Quit
(D)    View Data Collection Counters   (H)  Help
(B)    Display BIT Status
```

Press **Q** then **5 Enter** to quit the *User Interface*.

```
Exiting user interface.

#05110011
01/03/02,14:48:05,11,14,317,1,24,0,7.3,0.5,62,24,0,0,00
```

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APPENDIX N

RSOIS PARTS LIST

Find	ASN	Description	Manufacturer (CAGE)	Part Number	SMR Code
		RSOIS System			
	S200-1	RSOIS (complete, w/o heater, palletized)	CES (39825)		PAOOD
	S200-1A	RSOIS (complete, w/ heater, palletized)	CES (39825		PAOOD
		Remote Processing Unit			
	S200-1A1	Stainless Steel Enclosure (complete RPU w/ mounting hardware)	Hammond (93831)	1418N4SSD8LP/BNP	PAODD
	S200-1A1BT1	38AHr Battery - RPU Battery Backup	Yuasa (77280)	NP38-12	PAOZA
	S200-1A1FT1	RPU Remote Fiber Optic Driver	IFS (0T0G7)	D1010-C	PAOZD
	S200-1A1DES	Desiccant (D25-3)	Vaisala/Handar (1NJ14)	600-0005	PAOZZ
	S200-1A1P1	Connector w/ harness on S200-1A1 for Wind Sensor	CES (39825)	S1489	PADZD
	S200-1A1P2	Connector w/ harness on S200-1A1 for AT/RH Sensor	CES (39825)	S1490	PADZD
	S200-1A1P3	Connector w/ harness on S200-1A1 for Spare	CES (39825)	S1491	PADZD
	S200-1A1PS1	RPU Power Supply Module (Complete)	CES (39825)	S1472	PADDD
	S200-1A1PS1F1	Fuse, PSM (F1) 0.5 Ampere, Slow, 1 1/4 x 1/4, 250 V	Littel Fuse (75915)	315.500	PAOOO
	S200-1A1PS1F2	Fuse, PSM (F2) 1.0 Ampere, Slow, 1 1/4 x 1/4, 250 V	Littel Fuse (75915)	313001	PAOOO
	S200-1A1PS1F3	Fuse, PSM (F3) 10.0 Ampere, Slow, 1 1/4 x 1/4, 250 V	Littel Fuse (75915)	32601.2	PAOOO
	S200-1A1PS1F4	Fuse, PSM (F4) 10.0 Ampere, Slow, 5x20, 250V	Littel Fuse (75915	218010	PADZD
	S200-1A1PS1Z1	Surge Arrestor, 120VAC, 100KA, Category C	Delta Lightning (OBK55)	LA302	TBD
	S200-1A1RT1	2-Way Spread Spectrum Radio Assembly (RPU)	CES/Zeus (39825/1B8Q3)	Zeus-ZANT103	PAODD
	S200-1A1RT1HR1	RPU Radio Assembly heater	Omega (29907)	SRFG103/10-P	PAOZZ
	S200-1A1RT1W1	Antenna Cable (RPU)	CES (39825)	S1475	PAOZZ
	S200-1A1W1	10 foot DB9 Technician's Cable	CES (39825)	S1122Z	PAOZZ
	S200-1A1Z3200	Zeno®-3200 (System Data Logger @ RPU)	CES (39825)	S1471	PAODD
	S200-1A1Z3200F5	Fuse, Z3200/DC power input (F5) 2.0 Ampere, Slow, 1 1/4 x 1/4, 250 V	Littel Fuse (75915)	313002	PAOZZ

Find	ASN	Description	Manufacturer (CAGE)	Part Number	SMR Code
	S200-1A1ZE1	Zeno®-3200 1 Mbyte SRAM	CES (39825)		PADZD
		Directional Antenna			
	S200-1E1	Directional Antenna, Yagi (RPU)	MAXRAD (1CBB8)	MYP24008	PAOZD
		Temperature /Humidity Unit			
	S200-1A2	Temperature /Humidity Unit (Complete)	CES (39825)	S1492	PAOOD
	S200-1A2B1	RMY 43408F-12 Brushless Blower Motor w/Flow Switch	RMY (52314)	43447F	PAOZZ
	S200-1A2FL1	HMP45D Filter	Vaisala (1NJ14)	2787HM	PAOZZ
	S200-1A2HY1	RMY Motor Aspirated Shield 43408F-12 w/ mounting hardware	RMY (52314)	43408F-12	PAOZZ
	S200-1A2MP1	RMY 43408F-12 Skirt/Shield	RMY (52314)	43416	PAOZZ
	S200-1A2MP2	RMY 43408F-12 Top Cap/Cover	RMY (52314)	43482	PAOZZ
	S200-1A2MP3	RMY 43408F-12 Blower Cover Assembly	RMY (52314)	43448B	PAOZZ
	S200-1A2MP4	RMY 43408F-12 Mounting U-Bolts (2)	RMY (52314)	41053	PAOZZ
	S200-1A2MP5	RMY 43408F-12 Mounting Bracket Assembly (2)	RMY (52314)	43451A	PAOZZ
	S200-1A2MP6	RMY 43408F-12 Mounting Arm Clamp and Bolt	RMY (52314)	43456	PAOZZ
	S200-1A2MP7	RMY 43408F-12 Mounting Adaptor for S200-1A2RT45	RMY (52314)	43430-01	PAOZZ
	S200-1A2MP8	RMY 43408F-12 Split Bushing	RMY (52314)	43430	PAOZZ
	S200-1A2R1	HMP45D Shunt Resistor (4.99K +/- 1% @Zeno®-3200 in RPU)	Vishay/Dale (C3651)	PTF564K99BT-16	PAOZZ
	S200-1A2RT1	YSI Temperature Bead	YSI (1L9U5)	YSI44034	PADZD
	S200-1A2RT45	Modified Vaisala HMP45D (w/ YSI and RMY 43408/HMP45D Cable)	Vaisala/CES (1NJ14)	HMP45DU	PAODD
		Ultrasonic Wind Sensor			
	S200-1A3	425AH Ultrasonic w/ diagnostics w/ mounting hardware	Vaisala/Handar (1NJ14)	425AHW, SDI12	PAODD
	S200-1A3AT1	Margin Verifier	Vaisala/Handar (1NJ14)	425-7010	PEDZD
	S200-1A3MP1	Bird Spikes	Vaisala/Handar (1NJ14)	425-8017	PAOZZ
	S200-1A3MP2	Adapter/Mounting Cup	Vaisala/Handar (1NJ14)	425-8004	PAOZZ
	S200-1A3MP3	Mounting Arm w/ hardware	CES (39825)	S1478	PAOZZ
	S200-1A3R1	Shunt Resistor (1K @Zeno®-200 in RPU)	Vishay/Dale (C3651)	CF1/4 102J	PAOZZ

Find	ASN	Description	Manufacturer (CAGE)	Part Number	SMR Code
	S200-1A3W1	425AH Cable	CES (39825)	S1477	PAOZZ
	S200-TE-316	Solar Noon Alignment Tool	NWS		PEOZO
		Base Station			
	S200-1A4	2-Way Spread Spectrum Base Station	CES (39825)	S3889	PAODD
	S200-1A4BT1	Battery-Backup	Panasonic (0HF77)	LCR-12V5P	PADZA
	S200-1A4E1	Yagi Antenna (left hand threads)	CES (39825)	S1468	PAOZZ
	S200-1A4P1	Power Cable	CES (39825)	S1469	PAOZZ
	S200-1A4RT1	2-Way Spread Spectrum Radio Assembly	CES/ZEUS (39825)	S1466	PADZD
	S200-1A4W2	RS-232 Terminal Cable	CES (39825)	S1470	PAOZZ
	S200-1FT2	Fiber Optic Driver (Workstation)	IFS (OTOG7)	D1010-DB9	PAOZD
		Lightning/Ground System			
	S200-1A5E1	Lightning Rod/Grounding System w/ mounting hardware	CES (39825)	S1482	PAOZZ

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APPENDIX O

RESISTANCE vs. TEMPERATURE

Resistance Data for YSI 44034

Temperature		Resistance
°F	°C	Ohms
-112.0	-80	3,685,000
-110.2	-79	3,371,000
-108.4	-78	3,086,000
-106.6	-77	2,827,000
-104.8	-76	2,592,000
-103.0	-75	2,378,000
-101.2	-74	2,182,000
-99.4	-73	2,005,000
-97.6	-72	1,843,000
-95.8	-71	1,695,000
-94.0	-70	1,560,000
-92.2	-69	1,436,000
-90.4	-68	1,323,000
-88.6	-67	1,220,000
-86.8	-66	1,126,000
-85.0	-65	1,039,000
-83.2	-64	959,900
-81.4	-63	887,200
-79.6	-62	820,500
-77.8	-61	759,200
-76.0	-60	702,900
-74.2	-59	651,100
-72.4	-58	603,500
-70.6	-57	559,700
-68.8	-56	519,400
-67.0	-55	482,200
-65.2	-54	447,900
-63.4	-53	416,300
-61.6	-52	387,100
-59.8	-51	360,200
-58.0	-50	335,300
-56.2	-49	312,300
-54.4	-48	291,000
-52.6	-47	271,300
-50.8	-46	253,000
-49.0	-45	236,200
-47.2	-44	220,500
-45.4	-43	205,900

-43.6	**-42**	192,500
-41.8	**-41**	180,000
-40.0	**-40**	168,300
-38.2	**-39**	157,500
-36.4	**-38**	147,500
-34.6	**-37**	138,200
-32.8	**-36**	129,500
-31.0	**-35**	121,400
-29.2	**-34**	113,900
-27.4	**-33**	106,900
-25.6	**-32**	100,300
-23.8	**-31**	94,220
-22.0	**-30**	88,530
-20.2	**-29**	83,220
-18.4	**-28**	78,260
-16.6	**-27**	73,620
-14.8	**-26**	69,290
-13.0	**-25**	65,240
-11.2	**-24**	61,450
-9.4	**-23**	57,900
-7.6	**-22**	54,580
-5.8	**-21**	51,470
-4.0	**-20**	48,560
-2.2	**-19**	45,830
-0.4	**-18**	43,270
1.4	**-17**	40,860
3.2	**-16**	38,610
5.0	**-15**	36,490
6.8	**-14**	34,500
8.6	**-13**	32,630
10.4	**-12**	30,880
12.2	**-11**	29,230
14.0	**-10**	27,670
15.8	**-9**	26,210
17.6	**-8**	24,830
19.4	**-7**	23,540
21.2	**-6**	22,320
23.0	**-5**	21,170
24.8	**-4**	20,080
26.6	**-3**	19,060
28.4	**-2**	18,100
30.2	**-1**	17,190
32.0	**0**	16,330
33.8	**1**	15,520
35.6	**2**	14,750
37.4	**3**	14,030

39.2	**4**	13,340
41.0	**5**	12,700
42.8	**6**	12,090
44.6	**7**	11,510
46.4	**8**	10,960
48.2	**9**	10,440
50.0	**10**	9951
51.8	**11**	9486
53.6	**12**	9046
55.4	**13**	8628
57.2	**14**	8232
59.0	**15**	7857
60.8	**16**	7500
62.6	**17**	7162
64.4	**18**	6841
66.2	**19**	6536
68.0	**20**	6247
69.8	**21**	5972
71.6	**22**	5710
73.4	**23**	5462
75.2	**24**	5225
77.0	**25**	5000
78.8	**26**	4787
80.6	**27**	4583
82.4	**28**	4389
84.2	**29**	4204
86.0	**30**	4029
87.8	**31**	3861
89.6	**32**	3702
91.4	**33**	3549
93.2	**34**	3404
95.0	**35**	3266
96.8	**36**	3134
98.6	**37**	3008
100.4	**38**	2888
102.2	**39**	2773
104.0	**40**	2663
105.8	**41**	2559
107.6	**42**	2459
109.4	**43**	2363
111.2	**44**	2272
113.0	**45**	2184
114.8	**46**	2101
116.6	**47**	2021
118.4	**48**	1944
120.2	**49**	1871

122.0	**50**	1801
123.8	**51**	1734
125.6	**52**	1670
127.4	**53**	1608
129.2	**54**	1549
131.0	**55**	1493
132.8	**56**	1439
134.6	**57**	1387
136.4	**58**	1337
138.2	**59**	1290
140.0	**60**	1244
141.8	**61**	1200
143.6	**62**	1158
145.4	**63**	1117
147.2	**64**	1079
149.0	**65**	1041
150.8	**66**	1006
152.6	**67**	971.1
154.4	**68**	938.0
156.2	**69**	906.3
158.0	**70**	875.7
159.8	**71**	846.4
161.6	**72**	818.3
163.4	**73**	791.2
165.2	**74**	765.1
167.0	**75**	740.0
168.8	**76**	715.9
170.6	**77**	692.7
172.4	**78**	670.3
174.2	**79**	648.8
176.0	**80**	628.1
177.8	**81**	608.2
179.6	**82**	588.9
181.4	**83**	570.4
183.2	**84**	552.6
185.0	**85**	535.4
186.8	**86**	518.8
188.6	**87**	502.8
190.4	**88**	487.4
192.2	**89**	472.6
194.0	**90**	458.2
195.8	**91**	444.4
197.6	**92**	431.0
199.4	**93**	418.2
201.2	**94**	405.7
203.0	**95**	393.7

204.8	**96**	382.1
206.6	**97**	370.9
208.4	**98**	360.1
210.2	**99**	349.7
212.0	**100**	339.6
213.8	**101**	329.8
215.6	**102**	320.4
217.4	**103**	311.3
219.2	**104**	302.5
221.0	**105**	294.0
222.8	**106**	285.7
224.6	**107**	277.8
226.4	**108**	270.1
228.2	**109**	262.6
230.0	**110**	255.4
231.8	**111**	248.4
233.6	**112**	241.6
235.4	**113**	235.1
237.2	**114**	228.7
239.0	**115**	222.6
240.8	**116**	216.7
242.6	**117**	210.9
244.4	**118**	205.3
246.2	**119**	199.9
248.0	**120**	194.7
249.8	**121**	189.6
251.6	**122**	184.7
253.4	**123**	179.9
255.2	**124**	175.3
257.0	**125**	170.8
258.8	**126**	166.4
260.6	**127**	162.2
262.4	**128**	158.1
264.2	**129**	154.1
266.0	**130**	150.3
267.8	**131**	146.5
269.6	**132**	142.9
271.4	**133**	139.4
273.2	**134**	136.0
275.0	**135**	132.6
276.8	**136**	129.4
278.6	**137**	126.3
280.4	**138**	123.2
282.2	**139**	120.3
284.0	**140**	117.4
285.8	**141**	114.6

287.6	**142**	111.9
289.4	**143**	109.2
291.2	**144**	106.7
293.0	**145**	104.2
294.8	**146**	101.8
296.6	**147**	99.4
298.4	**148**	97.1
300.2	**149**	94.9
302.0	**150**	92.7
303.8	**151**	90.8
305.6	**152**	88.8
307.4	**153**	86.8
309.2	**154**	84.9
311.0	**155**	82.9
312.8	**156**	81.1
314.6	**157**	79.3
316.4	**158**	77.6
318.2	**159**	75.9
320.0	**160**	74.2
321.8	**161**	72.6
323.6	**162**	71.0
325.4	**163**	69.5
327.2	**164**	68.0
329.0	**165**	66.4
330.8	**166**	65.1
332.6	**167**	63.7
334.4	**168**	62.3
336.2	**169**	61.0
338.0	**170**	59.7
339.8	**171**	58.5
341.6	**172**	57.3
343.4	**173**	56.1
345.2	**174**	54.9
347.0	**175**	53.8
348.8	**176**	52.7
350.6	**177**	51.6
352.4	**178**	50.5
354.2	**179**	49.5
356.0	**180**	48.6
357.8	**181**	47.5
359.6	**182**	46.6
361.4	**183**	45.6
363.2	**184**	44.7
365.0	**185**	43.8
366.8	**186**	43.0
368.6	**187**	42.1

370.4	**188**	41.3
372.2	**189**	40.5
374.0	**190**	39.7
375.8	**191**	39.0
377.6	**192**	38.2
379.4	**193**	37.5
381.2	**194**	36.8
383.0	**195**	36.1
384.8	**196**	35.5
386.6	**197**	34.8
388.4	**198**	34.2
390.2	**199**	33.5
392.0	**200**	32.9
393.8	**201**	32.3
395.6	**202**	31.7
397.4	**203**	31.2
399.2	**204**	30.6
401.0	**205**	30.0
402.8	**206**	29.5
404.6	**207**	29.0
406.4	**208**	28.5
408.2	**209**	28.0
410.0	**210**	27.5
411.8	**211**	27.0
413.6	**212**	26.5
415.4	**213**	26.1
417.2	**214**	25.6
419.0	**215**	25.1
420.8	**216**	24.7
422.6	**217**	24.3
424.4	**218**	23.9
426.2	**219**	23.5
428.0	**220**	23.1
429.8	**221**	22.7
431.6	**222**	22.3
433.4	**223**	22.0
435.2	**224**	21.6
437.0	**225**	21.3
438.8	**226**	20.9
440.6	**227**	20.5
442.4	**228**	20.2
444.2	**229**	19.9
446.0	**230**	19.5
447.8	**231**	19.2
449.6	**232**	18.9
451.4	**233**	18.6

453.2	**234**	18.3
455.0	**235**	18.0
456.8	**236**	17.7
458.6	**237**	17.4
460.4	**238**	17.1
462.2	**239**	16.9
464.0	**240**	16.6
465.8	**241**	16.3
467.6	**242**	16.1
469.4	**243**	15.8
471.2	**244**	15.6
473.0	**245**	15.3
474.8	**246**	15.1
476.6	**247**	14.9
478.4	**248**	14.6
480.2	**249**	14.4
482.0	**250**	14.2

APPENDIX P

INSTALLATION OF FIBER OPTIC CABLE AND MODEM

P- 1 INSTALLATION

1. Place one end of fiber optic cable inside the cable pulling sleeve and firmly attach the cable pulling sleeve to the fiber optic cable using electric tape or equivalent, figure 33.

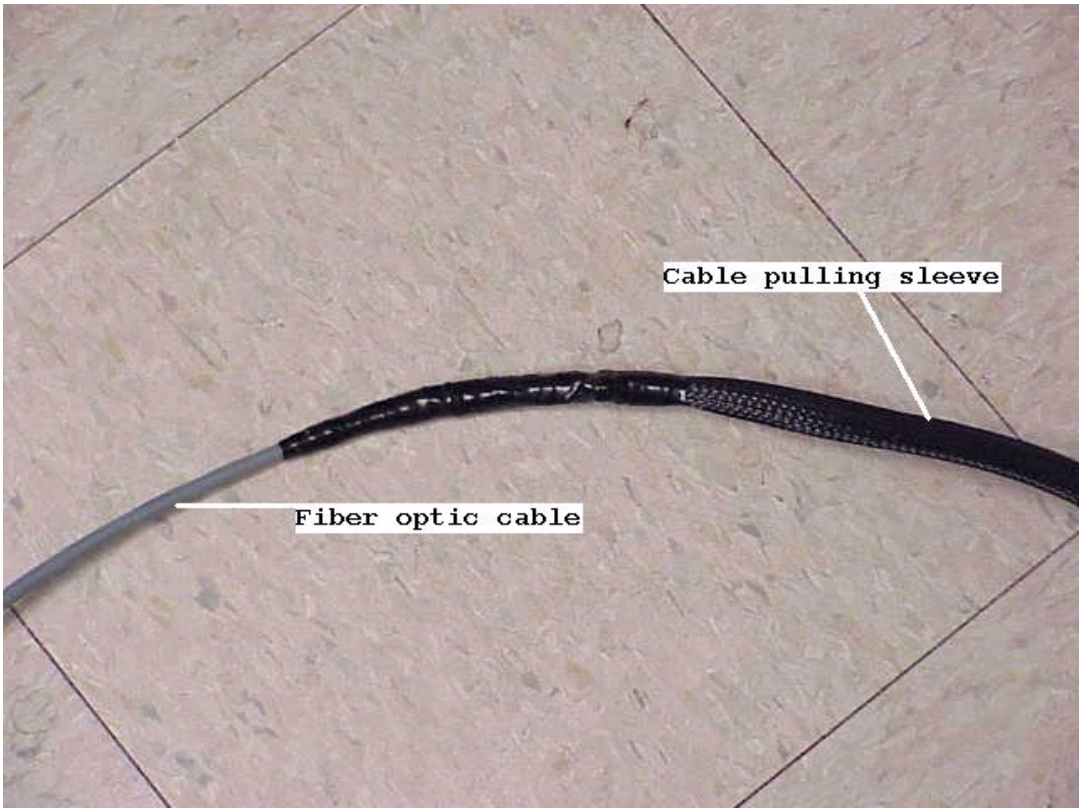

Figure 33: Cable pulling sleeve attached to fiber optic cable using electric tape.

2. Attach the looped end of the cable pulling sleeve to the end of the conduit string (or equivalent) and carefully pull the string and attached fiber optic cable through the conduit.

3. Pulling fiber optic cable isn't hard at all, since the manufacturer takes great pains to make sure the cable design protects the fibers during installation. Fiber cable can be pulled with much greater force than cooper wire if you pull it correctly. Just remember these rules:

   Do not pull on the fibers, pull on the strength members only! The cable manufacturer gives you the perfect solution to pulling the cables, they install special strength members, usually duPont Kevalar aramid yarn or a fiberglass rod to pull on. Use it! Any

other method may put stress on the fibers and harm them. Most cables cannot be pulled by the jacket. Do not pull on the jacket unless it is specifically approved by the cable manufacturer and you use an approved cable grip.

Do not exceed the maximum pulling load rating: On long runs, use proper lubricants and make sure they are compatible with the cable jacket. On really long runs, pull from the middle out to both ends. If possible, use an automated puller with tension control, but we've seen jobs done with a mule providing the pulling force!

Do not exceed the cable bend radius: Fiber is stronger than steel when you pull it straight, but it breaks easily when bent too tightly. If you put a kink in the cable, you will harm the fibers, maybe immediately, maybe not for a few years, but you will harm them and the cable must be removed and thrown away!

Do not twist the cable: Putting a twist in the cable can stress the fibers too. Always roll the cable off the spool instead of spinning it off the spool end. This will put a twist in the cable for every turn on the spool (the figure 8 puts a half twist in on one side of the 8 and takes it out on the other, preventing twists.) And always use a swivel pulling eye, because pulling tension will cause twisting forces on the cable. Make sure the cable is long enough for the run. It is not easy or cheap to splice fiber and it needs special protection. Try to make it in one pull, possible up to about 2-3 miles.

Conduit and Innerduct: Outside plant cables are either installed in conduit or direct buried, depending on the cable type. Building cables can be installed directly, but you might consider putting them inside plenum rated innerduct. This innerduct is bright orange and provides a good way to identify fiber optic cable and protect it from damage, generally a result of someone cutting by mistake! The innerduct can speed installation and maybe even cut costs. It can be installed quickly by unskilled labor, the fiber cable pulled through in seconds. You can even get the innerduct with pulling tape already installed. Fiber doesn't need maintenance or inspection.

4. Once the fiber optic cable is pulled through the conduit and the cable pulling sleeve is no longer needed, remove it from the end of the fiber optic cable.

5. Remove the protective caps from the fiber optic modem located inside the RPU, figure 34.

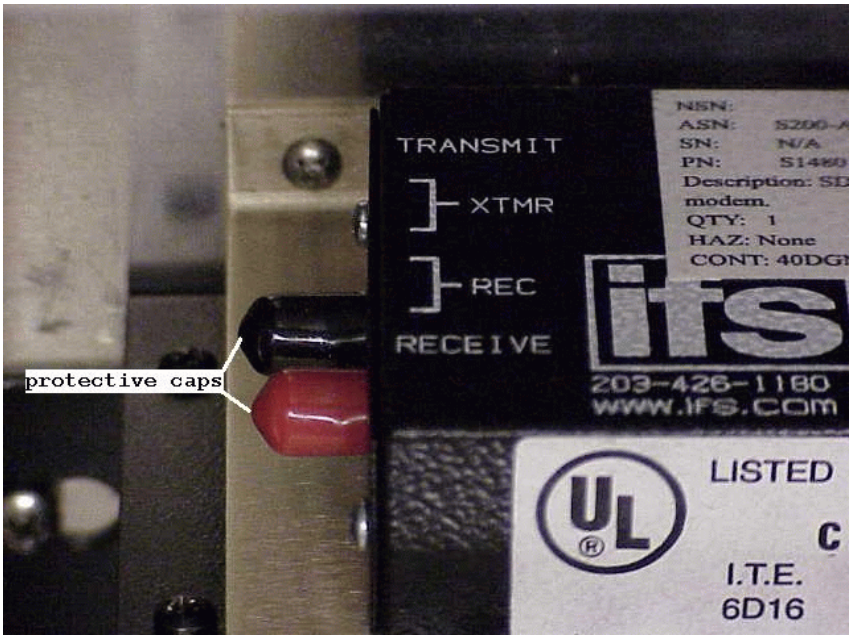

Figure 34: Fiber optic modem protective caps.

6. Remove the protective caps from the ends of the fiber optic cable at the RPU, figure 35.

Figure 35: Fiber optic cable protective caps.

7. Insert the **BLUE** cable into the XTMR port of the RPU fiber optic modem and twist-lock it into position, figure 36.

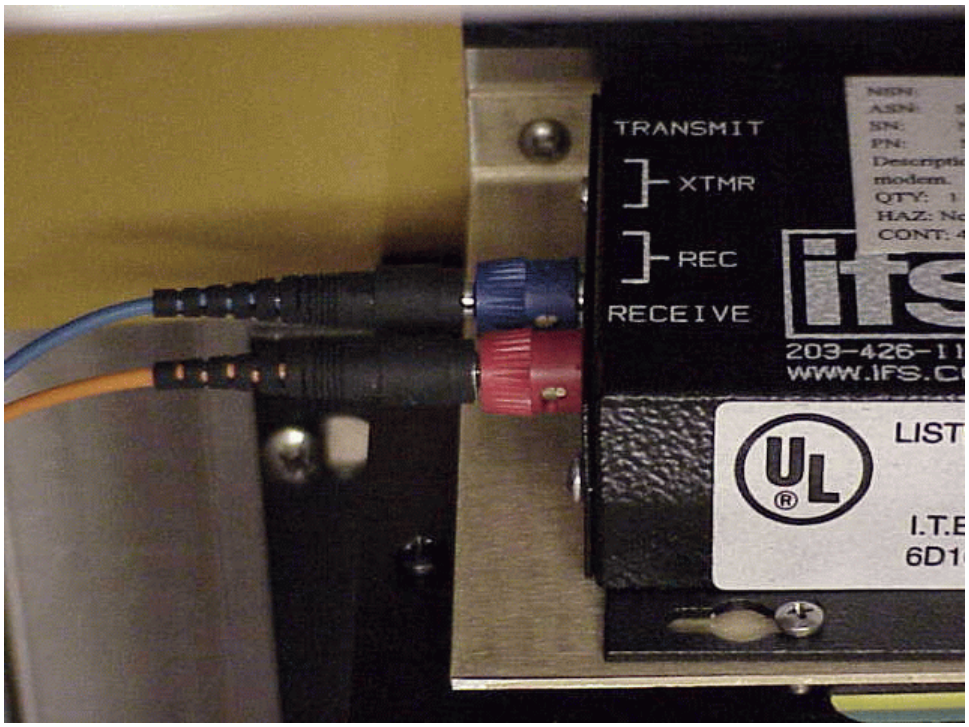

Figure 36: Fiber optic cable connected to RPU's fiber optic modem.

8. Insert the **ORANGE** cable into the REC port of the RPU fiber optic modem and twist-lock it into position, figure 36.
9. Remove the protective caps from the fiber optic modem at the workstation.
10. Remove the protective caps from the ends of the fiber optic cable at the workstation.
11. Insert the **ORANGE** cable into the XTMR port of the workstation fiber optic modem and twist-lock it into position, figure 37.

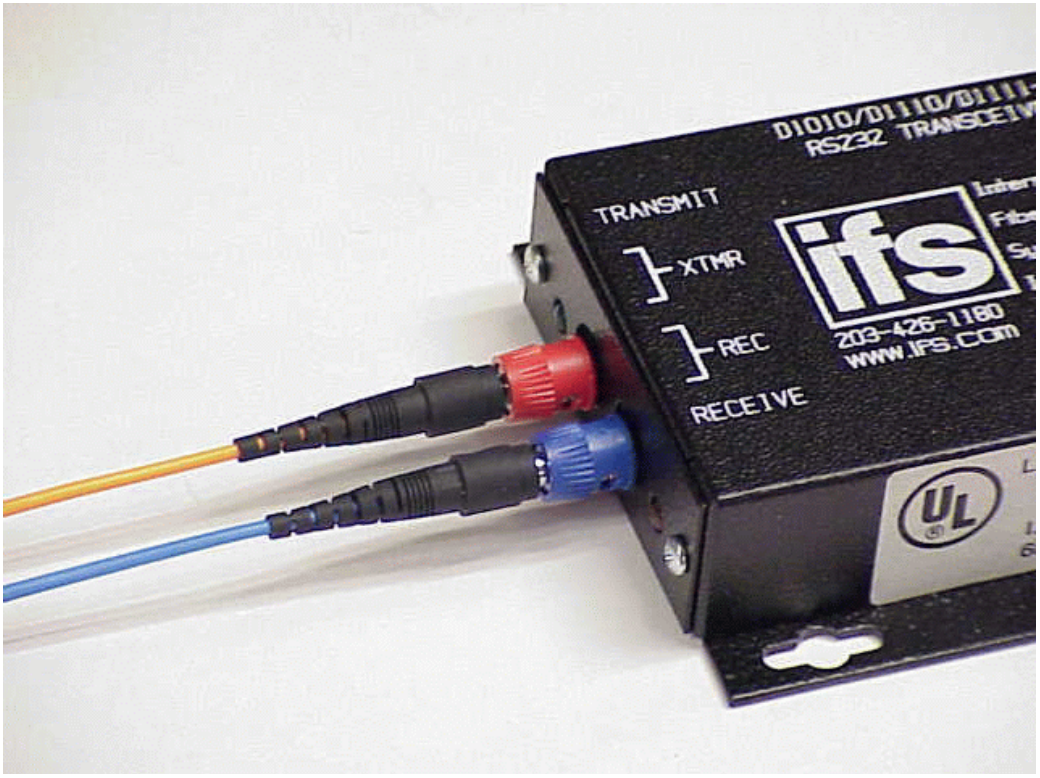

Figure 37: Fiber optic cable connected to workstation's fiber optic modem.

12. Insert the **BLUE** cable into the REC port of the workstation fiber optic modem and twist-lock it into position, figure 37.

13. Attach a serial cable from the RS 232 port of the computer to the RS 232, DB-9 port of the workstation fiber optic modem, figure 38.

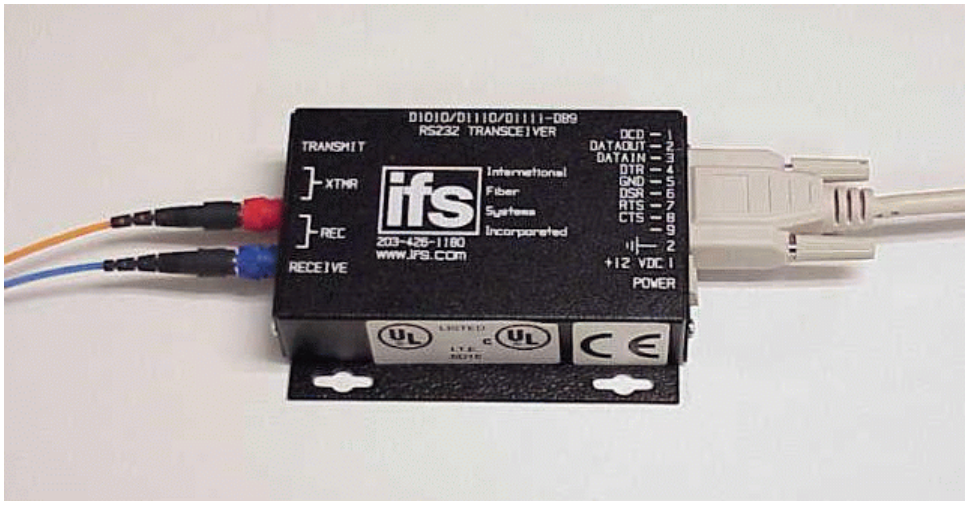

Figure 38: RS 232, DB-9 serial cable attached to fiber optic modem.

14. Attach the modem's power supply wires to the gray terminal block plug supplied with fiber optic modem. The wire with the gray dashes on the insulation is connected to terminal "1" of the terminal block plug and the other wire is connected to terminal "2", figure 39.

15. Attach the terminal block plug to the fiber optic modem's terminal block header, figure 39.

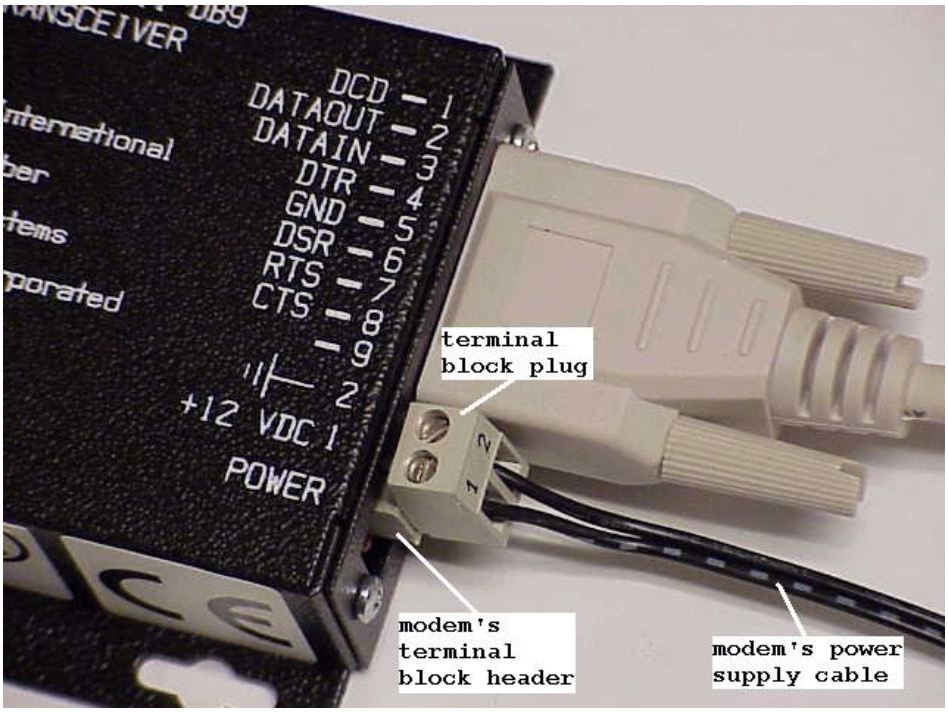

Figure 39: Power supply connected to workstation fiber optic modem.

16. Plug in the modem's power supply to the wall outlet. The modem is ON when the power indicator light, located on the right side of the modem, is illuminated, figure 40.

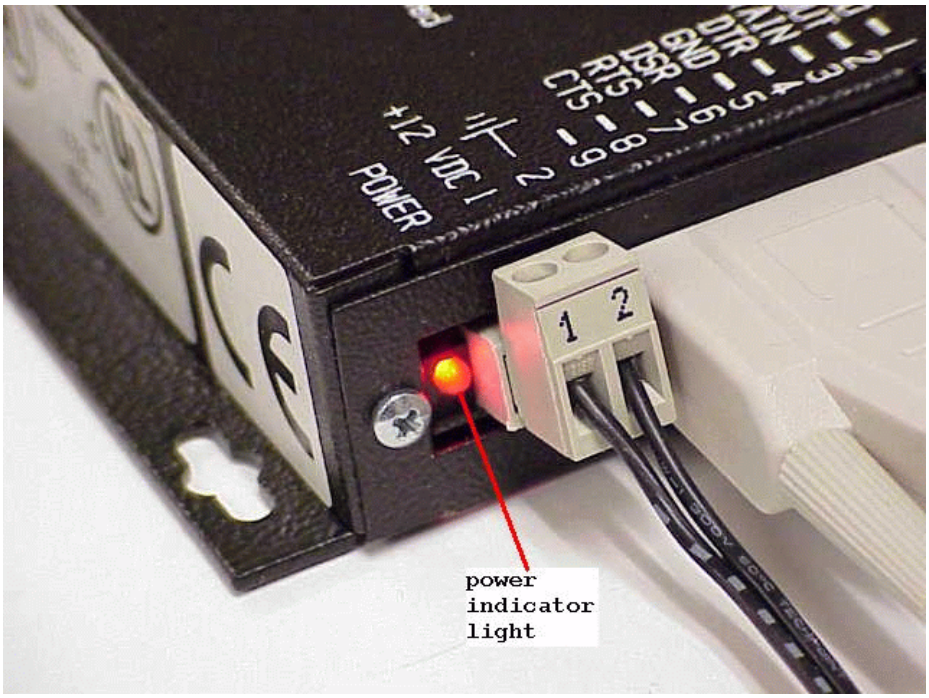

Figure 40: Power indicator light on workstation modem is ON.

17. To begin accessing RSOIS data using the workstation PC, open and setup Hyper Terminal or Procomm.

18. To open and setup Hyper Terminal, click "Start", go to the folder labeled "Program", then to "Accessories", then to "Communications"' then click on "Hyper Terminal".

19. In the Hyper Terminal folder, double click on Hyper Terminal icno to bring up Hyper Terminal.

20. In Hyper Terminal, under Connection Description, enter a name and click "OK".

21. Under Connect To, set "Connect using" to **"COM 1"** and click "OK".

22. Under COM1 Properties, set Port Settings as follows: "Bits per second" to **9600**, "Data bits" to **8**, "Parity" to **NONE**, "Stop bit" to **1**, and "Flow control" to **None**. Then click "OK", and "OK" again.

23. To open and setup Procomm, refer to Appendix D, SETUP PROCOMM.